PROCEEDINGS

Forty-Eighth Annual Convention
OF THE
American Railway Bridge and Building Association

1941

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THE
American Railway
Bridge and Building
Association

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H. M. Church
President, 1941

Proceedings of the

Forty-Eighth Annual Convention

(*Fiftieth Anniversary*)*

OF THE

American Railway Bridge and Building Association

Held at

CHICAGO, ILLINOIS

October 14-16, 1941

Published by the Association
A. G. Shaver, Secretary
310 So. Michigan Ave., Chicago

CARL GORR PRINTING COMPANY
1801 W. BYRON ST. — CHICAGO

*No annual conventions were held 1931—1933

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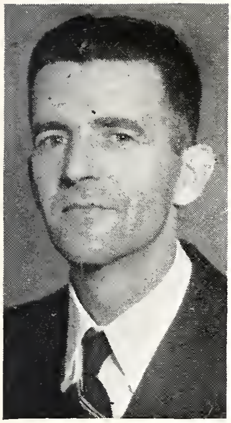
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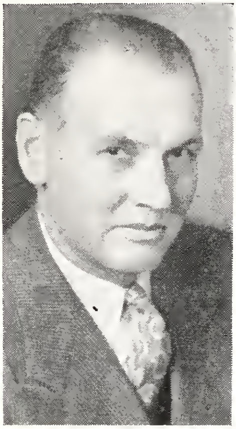
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(To be held at the Hotel Stevens, Chicago, October 13-15, 1942)

Wearing Surfaces for Building Floors, Platforms and Roadways

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J. A. Jorlett, asst. mast. carp., Penna., Jersey Shore, N. J.
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C. U. Smith, gen'l. mgr. & ch. engr., Board Harbor Com., Milwaukee, Wis.

Rail Fastenings on Bridges, Pits and Turntables

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Meeting the Demands for Increased Water Supplies in Fast Freight Service

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D. C. Shaddock, foreman wat. service, N. Y. C., Corning, N. Y.
J. L. Varker, supv. b. & b., D. & H., Carbondale, Pa.
M. P. Walden, asst. supv. b. & b., L. & N., Evansville, Ind.
K. J. Weir, special water insp., C. M. St. P. & P., Chicago.

Preventing Accidents Among Bridge and Building Employees

E. H. Barnhart, (chairman), div. engr., B. & O., Garrett, Ind.
W. A. Batey, (vice-chairman), sys. bridge insp., U. P., Omaha, Neb.
L. D. Garis, (vice-chairman), asst. gen'l. bridge insp., C. & N. W., Chicago.
J. C. Bird, b. & b., insp., N. Y. C., Corning, N. Y.
W. W. Gaines, bridge insp., C. & O., St. Albans, W. Va.
A. G. Dorland, asst. engr., E. J. & E., Joliet, Ill.
C. C. Eubank, br. insp., C. & O., Huntington, W. Va.
K. Hallock, supv. b. & b., C. & N. W., Pierre, S. D.
G. H. Holmes, supv. b. & b., M. P., Falls City, Neb.
E. H. Johnson, div. engr., C. M. St. P. & P., Miles City, Mont.
W. E. Maley, mast. carp., B. & O., Punxsutawney, Pa.
C. O. Sathre, asst. b. & b. supv., C. & N. W., W. Chicago, Ill.
J. W. Secker, system bldg insp., C. M. St. P. & P., Chicago.
H. E. Smith, engr. mtce., G. H. & H., Galveston, Texas.
W. A. Sweet, gen'l. foreman, A. T. & S. F., Newton, Kan.

The Repair of Steel Bridges

A. R. Harris, (chairman), asst. engr. bridges, C. & N. W., Chicago.
A. B. Chapman, (vice-chairman), office engr., C. M. St. P. & P., Chicago.
J. M. Salmon, Jr., (vice-chairman), asst. engr., L. & N., Middlesboro, Ky.
H. M. Buell, bridge insp., U. P., Omaha, Neb.
R. W. Cassidy, asst. cost engr., C. & O., Richmond, Va.
P. C. Chamberlain, bridge insp., Erie, Port Jervis, N. Y.
D. W. Converse, asst. engr., A. C. & Y., Akron, Ohio.
L. M. Frost, supv. b. & b., G. T. W., Battle Creek, Mich.
J. E. Heck, bridge insp., C. & O., Peru, Ind.
A. M. Knowles, asst. engr. struct., Erie, Cleveland, Ohio.
I. A. Moore, trainmast., C. & E. I., Salem, Ill.
R. H. Morrison, supt. b. & b., B. & A., Houlton, Me.
G. L. Sitton, ch. engr., Sou., Charlotte, N. C.
J. J. Wishart, supv. b. & b., N. Y. N. H. & H., Boston, Mass.

The Conservation of Bridge, Building and Water Service Supplies

F. G. Campbell, (chairman), asst. ch. engr., E.J. & E., Joliet, Ill.
M. D. Carothers, (vice-chairman), div. eng., C. & A., Bloomington, Ill.
W. L. Anderson, off. engr., C. & N.W., Chicago.
M. L. Bardill, asst. engr., C.M.St.P., & P., Savanna, Ill.
W. H. Begeman, b. & b. foreman, M. P., Jefferson City, Mo.
H. F. Bird, insp. b. & b., N.Y.C., Jersey Shore, Pa.
S. T. Corey, asst. bridge engr., C.R.I. & P., Chicago.
H. C. Johnson, instmn., C.M.St.P. & P., Ottumwa, Ia.
A. C. Jones, supv'r. b. & b., Sou., Parrish, Ala.
C. R. Knowles, supt. wat. service, I. C., Chicago.
L. R. Pennington, supv. b. & b., C. & N. W., Chadron, Nebr.
L. F. Pohl, asst. engr., C.M.St.P. & P., Miles City, Mont.
F. A. Scites, supv'r. b. & b. & w. s., C. & O., Huntington, W. Va.
C. W. Stephens, asst. engr. struct., D. & H., Plaza, Albany, N. Y.
L. Summers, w. s. repairman, M.P., Bismarck, Mo.

Piles and Pile Driving

W. F. Martens, (chairman), gen'l foreman b. & b. & w. s., A.T. & S.F., San Bernardino, Cal.
J. F. Lockwood, (vice-chairman), supv. of br. erection, C. & O., Richmond, Va.
C. F. Berg, supv. dftsman, C. &. N. W., Chicago.
L. G. Byrd, supv. b. & b., M.P., Poplar Bluff, Mo.

Piles and Pile Driving (Cont'd)

B. J. Chamberlain, scale supv'r., C. & E.I., Danville, Ill.
R. L. Cook, asst. engr., M.P., Houston, Tex.
M. H. Dick, eastern editor, Railway Engineering and Maintenance, New York.
F. G. Elmquist, bridge insp., C.M.St.P. & P., Chicago.
P. V. Elfstrom, dftsman, C. & N.W., Chicago.
L. I. Evans, instmn., C.M.St.P. & P., Savanna, Ill.
O. M. Glander, ch. carp., C.M.St.P. & P., Mason City, Ia.
A. E. Kiles, b. & b. carp., S.P., El Paso, Tex.
J. B. Lodeski, asst. gen'l. br. insp., C. & N. W., Chicago.
J. F. Montgomery, supv'r. b. & b., St.L. & S.W., Tyler, Tex.
E. E. Tanner, gen'l. supv'r. b. & b., N.Y.C., Albany, N. Y.

The Cleaning of Masonry Structures

W. A. Huckstep, (chairman), gen'l. bldg. supv'r., M.P., St. Louis, Mo.
H. M. Harlow, (vice-chairman), asst. gen'l. supv. b. & b., C. & O., Clifton Forge, Va.
F. W. Dayton, arch. dftsman, C. & N.W., Chicago.
L. C. Hinsch, instmn., C.M.&St.P. & P., Savanna, Ill.
C. Holland, asst. engr., C.M.St.P. & P., Minneapolis, Minn.
F. L. Koehler, div. engr., C. & O., Ashland, Ky.
S. E. Kvenberg, asst. engr., C.M.St.P. & P., Chicago.
M. Meyer, supv'r., b. & b., C. &. W.I., Chicago.
K. L. Miner, supv'r. b. & b., N.Y.C., Albany, N. Y.
H. J. Powell, painter foreman, N.Y.C., Malone, N. Y.
F. R. Spofford, supv'r. b. & b., B. & M., Boston, Mass.
M. Stein, engr. dftsman, C. & N.W., Chicago.
J. S. Vreeland, assoc. editor, Railway Engineering and Maintenance, Chicago.
L. C. Winkelhaus, arch. engr., C. & N.W., Chicago.
H. O. Wray, engr. m. w., T.C.T., Texas City, Tex.

PROCEEDINGS

MINUTES AND ADDRESSES

OPENING SESSION

Tuesday, Oct. 14, 1941

THE opening session of the Forty-Eighth convention of the American Railway Bridge and Building Association was called to order in the Stevens Hotel, Chicago, at 10:30 a.m., Tuesday, October 14, 1941, President H. M. Church, general supervisor of bridges and buildings on the Chesapeake & Ohio, presiding.

President Church: I will now call the meeting to order. Members and guests, it is a pleasure for me to welcome you to the Forty-Eighth annual convention of the American Railway Bridge and Building Association. We are prompted to seek Divine guidance in our deliberations, and it is fitting, therefore, that we pause at this time to be led in prayer by Dr. Harrison Ray Anderson, Pastor of the Fourth Presbyterian Church of Chicago. Dr. Anderson.

Dr. H. R. Anderson: I am glad that you men of the railway industry turning again to God, are beginning your meeting with a word of prayer. I come from a railroad family. My people helped build the old Kansas Pacific, which is now a part of the Union Pacific, and I was trained as an engineer. It is a great thing to see engineers recognize that unless God builds, we all labor in vain. So, in no formal sense, but in a very real and personal way, let us bow our heads and ask God's blessing upon this meeting. (Reverend Anderson delivered the invocation, while heads were bowed in silence.)

President Church: The worldwide influence of the American Railway Engineering Association gives testimony of the importance of that society today. It has a large working membership from the Canadian railways and a considerable membership from our good neighbor nations from the South. Its Manual of Recommended Practice and Specifications for roadway, track and structures are stand-

For the convenience of those using this volume, it is divided into two parts, one beginning with this page, presenting a running report of the convention, with suitable page references to the second part, which groups together the committee reports and various technical addresses.

ards that are outstanding in their general application and acceptance.

F. L. C. Bond, vice-president and general manager of the Central region of the Canadian National, and president of the A.R.E.A., had hoped to be with us this morning but found that the demands upon his time in supervising the wartime traffic on his lines were such as to make it impossible for him to leave his railway. He, therefore, has asked H. R. Clarke of the Burlington Lines, and first vice-president of the A.R.E.A., to represent him. Mr. Clarke.

Greetings from the American Railway Engineering Association

By H. R. Clarke, Vice-President

Mr. President, members of the American Railway Bridge and Building Association, ladies and gentlemen:

When I last saw President Bond about two months ago, at a meeting of the Board of Direction of the American Railway Engineering Association, he hoped to be here today; but at that time he expressed the fear that pending engagements would make that impossible. His absence is unavoidable, and is due entirely to the pressure under which every railroad officer today, not only in this country, but in Canada as well, is working. Mr. Bond is disappointed that he cannot be with us, and has asked me to convey his regret to you.

We are sorry that Mr. Bond could not be here to speak to us this morning, an assignment to which he was looking forward with pleasure, and we regret that at this time we cannot have a word of greeting and inspiration, not only from the president of the American Railway Engineering Association, but, as well, from a distinguished officer of a great railroad serving our friendly neighbor to the north—Canada.

It is also a disappointment that we have not been permitted to hear Mr. Gormley.* I am sure he would have brought us a message that would have been an inspiration and a challenge. He is in a position to know the railroad situation not only on one road, but on all roads. I suspect he would have said to us that we are facing taxes which are not going to be light, and which may become even heavier. If he had brought that message to us, he would have told us that every railroad officer who is interested in the future of the industry to which most of us have devoted ourselves, and who is concerned with his own future, is facing an assignment that is perhaps a bit more difficult than it was a year ago, and that may become still more difficult. But even had that message been brought to us, I am sure it would not have scared us, nor in any sense have given us the jitters. It would have been simply a word of warning; and to be forewarned is to be forearmed. Knowing the conditions confronting us, we can prepare to meet and overcome them.

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*Mr. Gormley, Executive assistant, Association of American Railroads, who, in an opening address, was to have preceded Mr. Clarke on the program, was detained at another meeting being held in Chicago at the time, and when Mr. Clarke made the comments in this paragraph, there was some fear that he would not be able to attend the convention at all. However, Mr. Gormley arrived later in the morning and his address is printed, beginning on page 15.

An unthinking person might say that these problems are no concern of ours; that they are for our executives and managements to solve. We know better than that. We know that these problems are of vital concern to every one connected with the railroad industry in any capacity whatsoever, be he officer, employee, supply man or investor; and the latter includes every owner of an insurance policy. In fact, the problems that confront the railroads today deeply concern the country as a whole, and it is unfortunate, not only for the railroad industry, but for the country, that this fact is not clearly recognized and acted upon vigorously.

One means of learning something about the problems which confront us, not only the large ones of a general character, but more especially, the problems of bridge and building construction and maintenance, which are our particular responsibility, is by attending and taking part in meetings such as this. Here, men interested in their work come together to learn more about it by discussions and exchange of ideas. Membership in this association is voluntary, and the work is done by volunteers and by those who are willing to be drafted. In that respect, this association and the American Railway Engineering Association are alike, each in its respective field is doing a splendid job for its members and for the industry as a whole.

In an association such as this, and in meetings of this kind, we gain by giving. The more freely we give of the information and knowledge we have, the more we profit, the more valuable we become to the companies we serve, and the more valuable this association becomes to its members and to the industry it represents.

Representing President Bond and speaking for him at his request, I bring you greetings from the American Railway Engineering Association, and express the wish that this, the Forty-eighth annual meeting of the American Railway Bridge and Building Association, may be the most successful and the most profitable that you have ever held. Under the able guidance of President Church and his staff, and in the light of your highly constructive program, I am sure that it will be.

President Church: Mr. Clarke, the Bridge and Building Association is privileged and pleased to have you with us and to receive your greetings. On behalf of the association, I thank you very much.

It was a pleasure for me to attend the recent convention of the Roadmasters' and Maintenance of Way Association and to learn more intimately of our closely related and common purposes. Greetings from the Roadmasters' and Maintenance of Way Association will be presented by Mr. A. B. Hillman, president of that association. He holds the position of engineer maintenance of way of the Chicago & Western Indiana and the Belt Railway of Chicago.

Greetings from the Roadmasters' and Maintenance of Way Association

By A. B. Hillman, President

The railroads of this country are now going through one of the most critical periods of their history. There is no need for me to attempt to outline the problems with which we are now faced. Men expert in their line have analyzed our needs and have presented a vivid picture of what lies ahead of us. You are all well aware of the fact that this is a much different period than any we have faced before.

There is not the slightest doubt but that the men in the maintenance department will rise to the emergency as they always have in the past. During lean years and good years, the maintenance department has been called upon to maintain the physical properties of the railroads in a manner that would permit the operating department to function with ever-increasing speed and with the utmost safety. We have done this with a very limited number of men and with limited material, until at times the tasks we were called upon to do seemed impossible. So far, however, track men and the bridge and building men have met every emergency in a very satisfactory and commendable manner.

Now again we are being called upon to assist the operating department to transport promptly and efficiently the materials needed in the national defense program of our country. This time, to keep cars rolling, our work must be carried on without hindrance to that department. There must be no interference with the operation of trains. We must do our work with the minimum amount of power and the minimum number of cars, and the cars we do use must be kept moving.

The Roadmasters' and Maintenance of Way Association and the Bridge and Building Association are very closely related; the main problems facing each are identical. The railroads have profited greatly from the close cooperation existing between these two associations.

Last month the Roadmasters' Association held its fifty-sixth annual convention, and I am sure that all who attended took home with them some new and valuable ideas that will greatly assist them in carrying on their work. Today you are opening your forty-eighth convention. A glance at the program shows that you will have considerable discussion regarding the handling of the new problems confronting bridge and building men. It is a real pleasure for me, as representative of the Roadmasters' and Maintenance of Way Association, to wish you a most successful and profitable convention. Each man present will receive much needed assistance in his line of work. Our railroads will benefit greatly, and our country, which is now so dependent on our railroads, will be better served by your having met here.

President Church: Mr. Hillman,

it is a pleasure for me to accept, on behalf of our association, your kind greetings, and I extend to you and the Roadmasters' Association our best wishes for a successful year.

Mr. Hillman: Thank you very much, Mr. Church.

President Church: During our convention, the Bridge and Building Supply Men's Association is holding an exhibition in the adjoining room. Our program is so arranged that all members can visit the individual exhibits without missing any of the meetings. These exhibits are of interest and all of our members will find it worthwhile to visit them. Many new innovations, tools, units of equipment and material are being shown. The respective representatives of the different companies will be glad to discuss their products with you.

The exhibit is well planned and diversified and has been arranged for our benefit. Your interest in it will be solicited by C. C. Rausch, president of the Bridge and Building Supply Men's Association, who I am pleased to introduce to you.

Greetings from the Bridge and Building Supply Men's Association

By C. C. Rausch, President

On behalf of the exhibitors at this convention of the American Railway Bridge and Building Association, I wish to extend a most cordial welcome, and invite all present to visit the exhibits and secure full information regarding the products and appliances on display. The representatives of the manufacturers will be more than glad to answer any questions about their products.

The number of exhibitors is greater this year than in 1940. Thirty-five manufacturers of materials and appliances used by the Railroad bridge and building departments are exhibiting. The displays are attractive and interesting. The opportunity is afforded during this meeting to get full information from the manufacturers about their products. When you get back on the job, reflect on what you have seen and heard during this meeting, and see if you can use the new knowledge gained to make economies in your maintenance work.

Tomorrow, the Bridge and Building Supply Men's Association will entertain the ladies. A luncheon is planned—also a trip, after lunch, through the Museum of Science and Industry in Jackson Park. This, we are sure, will be most interesting.

On Wednesday evening, at 6:30 p.m., the Bridge and Building Supply Men's Association will hold a banquet and entertainment in the Boulevard room of this hotel. The entertainment committee, headed by Paul Austin of Johns-Manville, and assisted by almost everybody else, assures me that this will be the greatest event in Chicago on Wednesday evening. The tickets are on sale at the registration desk, where you will find R. R. Barnham, secretary, and Miss Peterson, assistant to the secretary.

Printed programs of the social activities are available at the secretary's desk. These programs have a list of the members of the Bridge and Building Supply Men's Association and of their representatives who are in attendance.

It is our earnest hope that a good time will be had by all, and that the knowledge obtained here will be helpful to you when you get back on the job.

President Church: Mr. Rausch, we certainly thank you for the very interesting program that you have planned for us. On behalf of the association, I thank you.

M. J. Gormley Introduced

Through the years the American Railway Bridge and Building Association has enjoyed the hearty cooperation of railway executives. Their support has been an inspiration to us, spurring us on to greater activity. No executive, however, has ever given us greater encouragement than R. H. Aishton, himself a bridge and building man, who progressed step by step until he became chief executive of the Chicago & North Western, and then was made President of the American Railway Association. In these latter capacities, he was ably assisted by M. J. Gormley, who has proved himself an equally staunch friend of our association on many occasions. Mr. Gormley is now executive assistant of the Association of American Railroads, with headquarters at Washington, D. C. His acceptance of our invitation to open our convention at a time when he is confronted with many demands is another evidence of his interest in our organization. Mr. Gormley comes to us with an authoritative message on The Tasks That Lie Ahead of Us. I am happy to present Mr. Gormley.

The Tasks That Lie Ahead of Us

By M. J. Gormley

Executive Assistant, Association of American Railroads

M. J. Gormley

The subject assigned to me is "The Tasks That Lie Ahead of Us." A broad approach to this involves some of the abilities of a soothsayer, and I lay no claim to being in that class, but there are some people in Washington, I think, who might be classed as soothsayers, or fortune tellers if that term fits better, judging from the statements that have been made there as to the inability of the railroads to handle the traffic. These people have one advantage, as I have often said, and that is that they have none of the inhibitions of experience to interfere with their conclusions or judgment, and no responsibility for their statements.

I see no particular objection to statements of this character being made, providing shippers, the people most concerned, will keep in mind the source or basis upon which they are made, and how much consideration they should be given in the handling of their own business. Unless this is done, they are liable to create hysteria on the part of the shipping public about a possible shortage of transportation, which, in turn, might cause the shipment of more traffic than can be unloaded promptly at destination, thereby creating a so-called bottleneck in transportation by the forced use of cars for storage purposes — which is the only way a bottleneck can be created.

Quotes Johnson and Eastman

Emphasizing this point I wish to quote in part from a statement made by Commissioner Johnson of the Interstate Commerce Commission. Mr. Johnson has charge of the Bureau of Service of the Commission, with a force in Washington and in the field dealing with transportation problems.

"In all talks with the inspectors that the Commission employs to watch the use of cars, I have emphasized that in any talk about a possible car shortage there is danger of scaring those desiring to ship, and that the result of fright will be the very thing we are determined to avoid."

Now the Interstate Commerce Commission has a thorough knowledge of transportation. It has inspection forces that keep it informed of what is going on, in addition to the information it obtains from the Association of American Railroads, and is certainly in a better position to judge the ability of the railroads to meet the traffic demands than those not having available to them all of the experience and information at the command of the Interstate Commerce Commission.

Now let me right here quote again from a statement made by Chairman Joseph Eastman of the I. C. C. in a recent address:

"The railroads have functioned admirably and they have had wonderful cooperation from the shippers of the country. The air has been full of dire forebodings of a breakdown of railroad service, but thus far the prophets of disaster have been pleasantly disappointed, and I think it fair to say that the railroads have performed as well as any part of the national defense mechanism."

Certainly Commissioner Eastman could not be accused of overstating the case when he states that the railroads have performed as well as any part of the national defense mechanism.

Car Loading Estimates

The Shippers Advisory Boards make quarterly estimates of the cars they expect to ship. For the last quarter of this year their estimate is 11.8 per cent above the same quarter of 1940. Assuming that the Advisory Boards' estimate for the loadings in this quarter will prove to be correct, then the loadings for the year 1941 will be approximately 42,184,000 cars. The estimate of the Research Bureau of the Office of Production Management shows that 46,400,000 cars would be loaded this year. If the Advisory Boards' estimates are correct, then the OPM's estimate will prove to have been 10 per cent too high, or approximately 4,216,000 cars more than will be actually loaded. The fact that its estimate for 1941 at present is exceeding the actual loading by approximately 113,000 carloads per week will not, I hope, discourage the making of estimates for the future for the benefit of all interested. On the other hand, the estimate made by the Car Service division of the Association of American Railroads will, on this same basis, prove to be 1,285,000 carloads, or 3 per cent, less than the actual carloadings. Both of these estimates were made about the same time.

Now, in trying to get some idea of what the task ahead of us really is, let us take the OPM Research Bureau's estimate for 1942. This estimate shows that carloadings will exceed 1941 by 10 per cent. If we apply this 10 per cent increase to the actual loading for 1941 as now estimated by the Advisory Boards, then the estimate of the carloadings for 1942 will be 46,400,000 carloads, instead of 51,100,000 as shown by the OPM Research Bureau's figures. In other words, on the basis of the information available today, and using the figures that I have referred to, we will load 4,216,000 more cars than we did in 1941. Now as a matter of fact, no one knows whether the present rate of increase in traffic will continue or not. No one knows how much the production for defense will curtail other traffic.

In this connection, it should be understood that the OPM Research Bureau did not estimate the less than carload traffic—that was estimated by ourselves and added to their figures for carload traffic in order to give the whole picture.

Will Handle Traffic

In September, 1939, less than three weeks after the war broke out in Europe, the railroads told the public that there would be rail transportation adequate for traffic then in prospect, and that any additional equipment which might be needed as demands developed, would be acquired. They have made good on this statement to date, and they will continue to make good unless they are prevented by the government from obtaining the necessary materials for the repair of their present equipment, and for the construction of new equipment.

According to the latest figures, the railroads, during 1941, to and including September 30, have put 55,658 cars and 425 locomotives in service. In addition, they now have on order 88,829 cars and 671 locomotives. Therefore, quoting from Commissioner Johnson again:

"With a fair break in priorities for new cars, the railroads will be able to handle whatever volume of traffic there will be next June when the load may be expected to be heavy."

President Church: Mr. Gormley, I want to thank you on behalf of the association and everyone here present for the inspiring message that you have brought to us.

President Church's Address

The opening of this Forty-Eighth Annual Convention today marks the close of 50 years of service by the American Railway Bridge and Building Association. Through the untiring efforts of those who have gone before us, our organization has grown to its present size and scope of activities. It is our privilege and our duty to conduct the work of this association on the same high level. These yearly conventions may be termed the commencement exercises of our association in that they not only bring to a close a year of activity, but are the beginning of another year of facing problems dealing with bridge and building work.

The first meeting of our association was in St. Louis in 1891, and it is fitting and proper to pause at this time to render praise and thanks to the memory of those responsible for its organization. The ideals they strived for have resulted in the measure of success that we enjoy today. It should be the desire of everyone of us to continue their efforts to improve the position of our association.

I shall not attempt to trace the history of our association, for many of you are better fitted to do this. The value of its work is embodied in structures built over the railroads of the nation. The design and safety of these structures bear testimony to the untiring efforts of our founders, past members, present members, members of our committees and past officers who gave so unstintingly of their time and energy to insure the continuing success of our association.

When this association was founded, the railroads were in the process of expansion. Many parts of our country were still in a state of initial development, and in many sections the railroads were the only means of transportation. Railroad construction was of prime importance in the progressive growth and development of our nation.

At that time, labor cost was lower, timber was plentiful and inexpensive. Preservatives for extending the life of timber were not in general use in this country. Concrete was but little used, if at all, and stone masonry was employed whenever permanency was desired. Early equipment was light; progressive developments brought larger and heavier locomotives and rolling stock, with the result that the iron structures erected soon required replacement or reinforcement.

Today the railroads, although remaining the most universal means of transportation, have many competitors. The automobile, the truck, the steamship and the airplane all take traffic from the railroads. While railway history portrays an almost unbroken record of increased efficiency and economy, with continuous improvements in service, the railroads now face ever-increasing competition.

Maintenance Is Present Problem

Our problem today deals mainly with the maintenance and development of the existing lines of the railways. During the last 50 years, or during the life of our association, the railroads have kept abreast of the times, and for this fine record much credit is due to the employees charged with the maintenance of structures. Railroad maintenance has progressed each year, and our association has had an outstanding part in this progress. This progress has been in unison with our national progress, and for the last few years our national progress has been extremely rapid. Today, little is static—everything is in a state of flux. Radio, with the speed of light, brings to the most isolated homes news of events in the far corners of the globe. This is just one example of things commonplace today that were regarded as miracles only a few years ago.

The railroads have kept pace with this progress to a remarkable degree. Streamlined, high-speed passenger trains are in operation on many of our roads; schedules calling for almost 100 m.p.h. are not uncommon. Air-conditioned cars are standard equipment on many of our trains. Yet, passengers are being carried by our railroads at lower rates; in fact, many roads are advertising their fares as the lowest in history. This progress is confined not alone to passenger service, but extends to freight service as well. Merchandise and perishable freight are being moved at passenger train speeds, and at rates which are considerably lower than those in the past.

The general stepping up of both freight and passenger schedules presents many problems to the maintenance department. Refinement of line and surface is essential. The maintenance of train schedules is necessary. Slow orders must be reduced to a minimum and their duration must be brief. The national emergency presents new problems in the conservation of new materials and in closer attention to the use of second-hand materials.

To make the most of what we have, I suggest: Conserve the man-hour—employ better methods to do the work at hand, and make efficient application of those materials that are available; keep your tools and machines working and secure more units of work per man-hour; do not overlook that with increased speed of railway traffic, safety should have first consideration.

Bridge renewals and repairs must be programmed and scheduled to provide structures of a permanent character. Untreated timber must give way to treated timber. Concrete must replace stone masonry. Buildings used by the traveling public must be reconditioned and improved through the use of new materials and equipment to provide an inviting atmosphere. The modernization and streamlining of passenger stations present interesting problems and developments. Yet, as I have stated previously, the railroads must carry on this progress in the face of active competition, higher costs of materials and labor, and lower freight and passenger rates.

Many New Materials

These changing conditions necessarily demand more rigid economy. The maintenance department must share in this economy. This gives rise to many problems, and our association must give much study to the solution of these problems.

Recent typical building improvements have been characterized by the use of many new materials, such as glass blocks, stainless steel, aluminum, chromium and rubber in many colorful combinations, with a corresponding modernization of design. Asphaltum and asbestos combination wallboards and plyboards are also being used to a greater extent. By the experience already gained in the use of these products, and through discussions of their problems with the representatives of manufacturers here at this convention, maintenance officers, in planning their programs, will be better able to select the materials that are more readily available, without interfering with the needs of our national defense program.

New Building Products

The new developments in freight and merchandising necessitate many improvements and changes in freight stations, transfer platforms and other facilities, bringing to the fore problems of floor and roof materials, which will be discussed in the reports presented during the sessions of this convention. Creosoted and salt-treated gum wood (permitting the probable increased use of the less durable hardwoods), creosoted wood blocks, steel plates, and many concrete and bituminous products, possess many advantages. There is also a trend toward modern doors of generous width that will facilitate the use of tractors, motor trucks and trailers.

As in the case of buildings, marked advancement has been made in bridge construction and maintenance, involving new materials and power tools and machines. Tubular piles for foundations, aside from their other advantages, have expedited the use of off-track equipment. Steel piles of the "H" section type and reinforced concrete piles have brought about new practices in the design of piers and abutments. Flat-slab bridge decks and solid plate floors on steel spans, without ballast, are increasing in use.

Many Improvements

Cement technology has advanced rapidly, and the recent adoption by the American Society for Testing Materials of five types of cement is an indication of recognition of the progress which has been made in this regard. Some of the directions of the progress have been fine grinding to increase strength, regulation of the aluminate content of the cement clinker to improve corrosion resistance, and control of heat evolution to reduce cracking from this cause. The incorporation of other materials has also been recognized and offers further opportunities for improvement in such properties as workability, strength, durability and economy.

Modern fuel and water stations have outstanding economic advantages and have presented attractive inducements to railway management in the planning for higher maintenance standards. The progress that has been made in water service is exemplified by the water station of modern design, the introduction of automatic pumping facilities, and the great strides that have been made in water treatment. At a recent meeting, the Railway Boiler Makers Association reported that 262,500,000 lbs. of scale-forming solids are being removed annually from treated locomotive water supplies, representing a reduction of approximately $35,125,000 annually in the expense of operating and maintaining locomotives. That further expansion of this important work is possible, is seen in the fact that less than 75 per cent of the boiler feed water now being used is treated.

We can extend these thoughts for remodeling and rebuilding to our roadside buildings, in order that shacks used for tool houses, etc., be converted with the aid of modern materials into neat, well-designed buildings to form a presentable part of the fixed properties of the railroads.

This year, the eight following subjects were chosen for study by our committees:

(1) Possibilities for Off-Track Equipment in Bridge Construction and Maintenance
(2) Maintenance and Repair of Bridge and Building Equipment
(3) Protection of Bridges and Roadway from Bank Erosion
(4) Welding in Water Service
(5) Wearing Surfaces for Building Floors, Platforms and Roadways
(6) Modernizing Small Stations to Meet Present-Day Requirements
(7) Efficient Methods of Transporting Bridge and Building and Water Service Gangs
(8) Recent Developments in Paint Removal

The reports of our committees have been published in Railway Engineering and Maintenance and distributed for your use. We are indebted to Past-President Elmer T. Howson and his editorial staff for this and other assistance rendered our association.

I desire to pay tribute to Past-President Sheridan C. Tanner, retired shop superintendent of the Baltimore & Ohio, who passed away at his home in Martinsburg, W. Va., on April 2, after a long illness. I was associated with Mr. Tanner in Baltimore during World War I, and his untiring energy and loyalty will always linger with me as pleasant memories. His obituary appears in the August, 1941 issue of the B&B News.

Asks Discussion

There has been a noticeable lack of discussion of the reports in recent years. I therefore, ask each and every one of you to contribute to the spirit of the meeting in discussing the questions raised. You have, no doubt, solved some problems by individual effort, and the benefit of your experience when explained informally is greatly appreciated by those in attendance. A problem that may be of concern to you may be solved by someone's answer. That would be of assistance to you, of benefit to your railroad, and valuable information for the record. The opportunity and privilege extended to us by our respective railways to be here, presents us with an individual responsibility to bring to these meetings some information or ideas that will be helpful in solving the problems of railway maintenance and operation.

The B&B News, issued by the Publication committee, and the 1940 proceedings, improved by the Typography committee, have created favorable comment. Our present membership of 594, including 50 new members, shows a net loss of 16 members as of September 30, 1941, over the preceding year. However, due to 7 deaths, 22 resignations and 38 members dropped because of failure to pay dues, there was a total decrease of 67, or 38 more than were lost through similar causes during the preceding year.

Must Move Forward

No organization can remain stationary. We need new blood or we must pass out of existence. *There is no other option or alternative.* Solicitation of new members by letter alone will not suffice — personal contact is required, as you all know that men comply more readily to requests from their friends.

Until recently, railroad employment has been on the decline. However, that situation has changed, and no doubt every member is personally acquainted with one or more new employees engaged in bridge and structural work who would be glad to join our association if invited to do so. Oftentimes these new employees know nothing of our organization, but are very desirous of increasing their knowledge of the work they have chosen. To solicit the membership of such an employee would be doing him a great favor, and would be greatly appreciated by all of us. Let us all assume the duty of bringing one or more new members into our association during the next year.

The increased activity in and broadening scope of bridge and building work, and the increasing use of machines in this work creates an incentive for younger men to enter railroad work. This has reached sufficient importance on some of the railways to warrant the inauguration of special courses of training through the use of apprentice systems and trade schools. The problems of national defense will bring new subjects that will merit our serious consideration and study in the days that are ahead.

Supervision Important

The problems of proper supervision in the railway industry were presented to us in an address at our annual luncheon last year by Bruce E. Dwinell, general attorney of the Chicago, Rock Island & Pacific. When speaking of his connection with the national committee dealing with labor matters, Mr. Dwinell emphasized the importance of the supervisor and foreman and of their responsibility in seeing that their men understand and co-operate in carrying out the contractual obligations between management and employees. "They are in direct contact with the workman," he said, and on them rests the responsibility to see that the rules and working conditions are maintained and applied in a fair and reasonable manner." I invite your attention to the thought that when supervisors and workers understand what management is doing and the reason for its policies, the reward is a degree of co-operation that cannot be obtained to the same extent by any other means.

In the long run, it will be discovered that the technic found effective in creating a satisfactory family life is applicable to industry. We are then reminded of the tools we work with—the five "M's"—"Men, materials, money, machines and morale." Through the proper co-operation between labor and management, the result is increased industrial efficiency, lower costs, and a general trend toward a better economic system, in which it is possible for both employees and management to enjoy a sense of satisfaction in their jobs.

Work, satisfaction and loyalty are our every-day obligations and guides to individual initiative, which is essential to the collective forces that motivate the American way of life and free enterprise. Railway employees, by their efforts, can do much to promote a better understanding of the indispensable place of the railways in this period of national emergency.

During the last year, I have had the benefit of the experience gained by the past-presidents of our association. I thank them for their wholehearted co-operation. I wish also to thank the officers of the association for the assistance that they have given to me in the direction of the affairs of the association during my stewardship. The chairmen and members of the various committees have spent many hard and tedious hours in the preparation of their reports. I greatly appreciate their efforts to make this meeting a successful one.

I thank the association for having chosen me for its president. My tenure has been delightful. I deem it a privilege to be the president of a body of men of the character that comprise the membership of our association. I am sure that the hours of this convention will be both pleasant and instructive to us all.

President Church: We have received a few messages that I think appropriate to read at this time. One is from H. I. Benjamin of the Southern Pacific, as follows:

Oct. 13, 1941

H. M. Church, President
American Railway Bridge and
Building Association

On this the fiftieth anniversary of the B. & B. Association, permit me to wish you and members of the convention a most successful gathering and continued success for the future. Regret very much my inability to be with you. Best regards.

H. I. Benjamin.

President Church: We have received several letters lately from Mr. George W. Rear of the Southern Pacific, but just this morning we received a special message from him from San Francisco. Mr. Rear, as you will recall, was with us last year. He is one of our past presidents whom we will miss this year. Mr. Rear has wired as follows:

Oct. 13, 1941.

H. M. Church
Hotel Stevens
Chicago.

We wish you and all of those in attendance a happy and prosperous meeting. It should be a fine meeting and with many old members in sight. Regret inability to be with you.

Geo. W. Rear

T. H. Strate (C. M. St. P. & P.): Mr. President, our Treasurer, F. E. Weise, is missing from this meeting, the first he has missed in many years. He is confined to his home by illness. I move that the secretary be instructed to send a telegram of greetings to Mr. Weise at his home.

Armstrong Chinn (Alton): I second the motion.

(The motion carried unanimously and the following telegram was sent:)

Oct. 14, 1941

Fred E. Weise,
W. Touhy Ave., Chicago.

Members B. & B. Association extend greetings and best wishes. Sorry you can't be with us.

F. O. Whiteman,
Secretary

President Church: Before we go to the next order of business, I will introduce the men on the platform.

R. E. Dove, our first vice-president, whom you all know; F. H. Soothill, our second vice-president; Armstrong Chinn, a past-president; T. H. Strate, another of our past-presidents; A. E. Bechtelheimer, our most recent past-president; C. R. Knowles, another of our past-presidents; and A. M. Knowles, our fourth vice-president.

Committees Appointed

President Church: I will now read the names of those appointed to our Special committees.

Nominations: C. M. Burpee, chairman; T. H. Strate, C. R. Knowles, E. T. Howson and Armstrong Chinn.

Subjects: R. E. Dove, chairman; G. S. Crites, A. M. Knowles, K. L. Miner, R. E. Caudle, I. A. Moore, A. E. Bechtelheimer and E. T. Howson.

Auditing: T. H. Strate, chairman; R. P. Luck, Martin Meyer, J. P. Hanley, Geo. E. Boyd and F. O. Whiteman.

Resolutions: N. D. Howard, chairman; F. W. Hutcheson, R. E. Caudle, S. S. Long and R. W. Cassidy.

Convention City: F. H. Soothill, chairman; N. D. Howard, W. A. Sweet, L. G. Byrd, H. T. Livingston and A. B. Chapman.

Obituary: A. E. Bechtelheimer,

chairman; L. D. Hadwen, J. E. Hogan, F. E. Weise, G. S. Crites and L. E. Peyser.

President Church: The protection of bridges and roadway from river bank erosion is a subject of considerable magnitude and a vital factor in today's railway operations. We will now listen to the report of our committee on this subject, of which A. B. Chapman, office engineer of the C. M. St. P. & P., Chicago, is chairman.

. . . Mr. Chapman presented the report (See page 55), following which President Church adjourned the morning session, with the following comment.

President Church: It would probably be well to adjourn now and to be back here, ready to discuss this report, at 2 p.m. I might add before we leave that 78 members had registered up to just a few minutes ago, which compares with 117 registered at about this time last year.

. . . Recessed at 12:20 p.m.

Afternoon Session

Tuesday, Oct. 14, 1941

The meeting was called to order at 2:15 p.m., President Church presiding.

President Church: Gentlemen, the subject of the protection of bridges and roadway from river bank erosion, as presented in the report this morning, is a very interesting and important one, and we shall now open the discussion of it. (See page 55.)

President Church: We will next hear the report of the Committee on the Possibilities of Off-Track Equipment in Bridge Construction and Maintenance. This report will be presented by H. T. Livingston, engineer of bridges of the Chicago, Rock Island & Pacific, who is chairman of the committee.

. . . Mr. Livingston presented the report. (See page 75.)

President Church: In order that we may catch up on our program, and so that we may devote a little more time to the discussion of this valuable report, and at the same time do justice to the very interesting exhibit which has been prepared for us out in the other room, I suggest delaying the discussion of this report and will ask C. M. Burpee to come to the platform and introduce our next speaker, Mr. P. O. Ferris.

. . . Mr. Ferris then read his prepared paper (See page 88), after which President Church said as follows:

President Church: I feel the excellent talk we have just listened to has left us better prepared to discuss Mr. Livingston's report on the Possibilities of Off-Track Equipment in Bridge Construction and Maintenance. However, since we are a little late, we will put off that discussion until tomorrow morning. Besides, I think we should spend a little time viewing the exhibits while so many of us are here.

I want to stress that our session tonight will start promptly at 8 p.m. In the interval between now and then, you will have a good opportunity to view the exhibits.

. . . Recessed at 4:12 p.m.

Commemorate 50th Anniversary

Evening Session, Oct. 14, 1941

C. R. Knowles

The session was called to order at 8:15 p. m., President Church presiding.

President Church: This is a memorial session that we are holding this evening. As such, I shall turn the meeting over to men who have been previous presidents of this organization, and who have served as members a longer time than I. Mr. Howson, have you a few remarks to make?

Elmer T. Howson (Ry. Eng. & Mtce.): Before we proceed to the program of the evening I want to remind everyone again of our annual luncheon tomorrow noon. Those of us who have been working on the preparation of the program feel that we have a rare opportunity tomorrow to get a very interesting inside picture of some of the work that is being done with and through railroad men to maintain the continuity of railway service in these uncertain days. It was my privilege not long ago to sit in a conference with J. Edgar Hoover, head of the Federal Bureau of Investigation, and to listen to the things he told us, some of which were as amusing as they were interesting. It is remarkable what things are being done. We think of the great detective work of the F.B.I. Sometimes it doesn't require a great deal of detective work to catch things that the layman overlooks.

Mr. Hoover hoped to be here tomorrow, but had another engagement; so he is sending his first assistant to talk with us railway men on how to protect railway structures against sabotage in these days of near war, if not actual war. I think every man in the room should be at the luncheon tomorrow to measure up to his responsibility to his railroad, to be able to carry back to his road the message that Mr. Hoover will have for us.

Before we extended an invitation to Mr. Hoover, I called Mr. Buford, vice-president of the Association of American Railroads, to be sure that there was nothing in our plan that might be prejudicial to the interests of the railroads as an industry in this country. Without a moment's hesitation, Mr. Buford said, "If you can get Edgar Hoover, do it. He will have something for you." I think it is not only an opportunity but also a responsibility for every railroad man to be present tomorrow to get that story, because in so doing, he is going to learn something and be able to serve his railroad better.

Old Timers Recalled

Now, proceeding with the program of the evening. Many of us have had more birthdays than we like to admit. Many of us in this room have had our fiftieth birthday. But there are few associations that have had fiftieth birthdays. Ours is one of them. In the engineering and maintenance of way field, there are only two associations that have had a continuous existence and a record of continuous service to the railways extending over 50 years. The American Railway Bridge and Building Association is one of those two. It was 50 years ago this fall that bridge and building men first met in an organization that has developed into this fine institution.

There has been a rapid turnover in this organization in that interval of time. There are men in this room who, possibly, attended conventions of our association before I did. This is my thirty-first consecutive convention. I am proud of that record. And in those 31 years, it has been my privilege to know most of the men who laid the foundation of this association—not all of them, but those who were most active. As we hear something of those men tonight, I hope that it will bring back to you on your respective railways your acquaintance with at least a few of these men whom you may have regarded as old men when you were young men in the service. Those men laid a splendid foundation, and it is on that foundation that this structure has been built that has carried through.

It has seemed fitting to recognize this anniversary and to call to the attention of the younger men, who may not know any of the people who will be referred to as among the pioneers of this association, some of the things that were done to make this a really worthwhile association. I want to do this so that you who have become members more recently may share with the old timers pride in the association, and may feel a responsibility to take up where those old timers left off, and where the men whom you regard as old timers among us today will soon leave off, in order that the essential service rendered to the railways by this association may be perpetuated.

It is difficult to visualize the kind of bridge, building and water service maintenance organizations we might have on our individual railways if we had not had the value of the teamwork in this association through the years.

Presents C. R. Knowles

Tonight, one of our members, a man whose experience goes back some 30 years in this association, or more than half its history, is going to speak of personal experiences over these years; he is going to speak from the record, from the history of the years that preceded him, and then he is going to throw on the screen pictures of early meetings and of early characters. We are sorry that some of the real old timers aren't here tonight to join in some of the reminiscing, something that we believe will be inspirational to all of you, as well as to bring back pleasant recollections to many of our older members.

It so happens that the oldest living past-president of this association lives in Chicago, Walter Rogers. He was president 40 or 41 years ago. But I am not going to steal the story from Mr. Knowles. Mr. Knowles is an old timer himself in this association, and he is going to tell you from those years of antiquity, how this association happened to be, what it has done, and possibly a little of the hopes and the responsibilities of those of us who are carrying on where others have left off. He is going to lead us in our celebration of our fiftieth birthday party. I am not going to introduce Clarence Knowles to you, because every one of you know him. I am merely going to present him.

C. R. Knowles: Mr. President, Mr. Howson, fellow members of the association, ladies and guests: I don't know why in the world I was picked on for this job, but I will endeavor to do my best. I will overlook the remarks of the master of ceremonies in regard to my age. I will say, though, that he is older in the association than I am. I came in the year after Mr. Howson. I can't claim any originality for a talk of this kind. I have simply tried to take items from the record which I thought might be of interest.

Greetings from Geo. Rear

I received a copy of a communication a few days ago, addressed to President Church, which I desire to read.

October 9, 1941

Dear Mr. Church:

I regret not being able to attend the convention this year, but I know that the usual spirit of friendliness and cooperation will exist.

At the Anniversary meeting Tuesday evening, if there is opportunity, I will be glad to have the enclosed letter read, and if agreeable have Mr. Peyser read it. He has a copy.

Yours truly,
Geo. W. Rear

It is typical of the loyalty and helpfulness of the members of this association that Geo. Rear should reach out from the Pacific Coast and furnish his bit toward the evening's program. I would like to ask L. E. Peyser if he will present Mr. Rear's remarks.

L. E. Peyser (S. P.): It is my pleasure and privilege to be entrusted with a message to you from one of this association's older members; a former President, and one who always had at heart the interests of the organization as witnessed by his constant labors in its behalf.

Some of you have known him for a longer period of time than I, as my association goes back for only about 20 years, but none can have a greater appreciation of his worth as a man, as a friend and a technician. You who know him well can best evaluate him—I refer to George Rear, engineer of bridges of the Southern Pacific Company, who has asked that I bring you his greetings on this occasion.

October 9, 1941.

President Church and Friends:

I envy Clarence Knowles the opportunity of recalling to the old-timers, and presenting to the newer members, some of the early history pertaining to the formation and development of the American Railway Bridge and Building Association. I do not believe I will be stealing any of his thunder if I recall a few incidents which, if he recalls them, will be in a different manner. I envy you your opportunity to listen to his presentation and will longingly wait to see it in print.

The need for such an association is probably not as well understood today as it was 50 years ago when O. J. Travis called together in St. Louis a band of about 20 men occupying similar positions on various railroads for the purpose of improvement. Improvement of what?—not their salaries, not of their official standing or the grip on their jobs—but of one thing only—the improvement of their knowledge and ability to perform the work of their departments. While the organizers were short on members, they were considerably longer on titles. The first title was The American International Association of Railway Superintendents of Bridges and Buildings.

This first meeting laid the course and it is remarkable how well the various pilots have followed the star so clearly outlined by the early officers. Up to that time, each railroad followed its own methods and each superintendent of bridges and buildings depended only on his own experience and judgment. This first meeting was the only one to which the ladies did not go, but to all others their attendance was invited and appreciated.

Perhaps at the present meeting some of us can speak the magic words and be able to hear (and perhaps see, in the mind's eye) the various meetings pass in review one by one, each providing its share of the wealth of knowledge, friendship and development that have been so characteristic of the association's gatherings. Or perhaps, by some more potent magic, there can be conjured up an unseen review of those who have left their influence so strongly on the association in the years gone by. But I am trespassing on Mr. Knowles' prerogatives, which I have no desire to do.

At the first meeting a resolution prevailed unanimously—conveying the thanks of the association to Mr. Travis for his indefatigable efforts in bringing about the organization. Perhaps another resolution of this date would be in order.

At the time this is read, we will wish we were with you, and regret the miles of mountains and plains that separate us. Our thoughts will be with you.

Geo. W. Rear.

C. R. Knowles: I cannot resist the opportunity to quote from a note I received from George accompanying his remarks as read by Mr. Peyser as follows:

Dear Clarence:

It is still summer here.

If your review of 50 years is not to be printed

(A) Could you send me a copy
(B) Would you
(C) I would if I were you
(D) and you were me.

As ever (only older)
Geo. W. Rear.

Past-President C. R. Knowles Reviews History of Association

The American Railway Bridge and Building Association was 50 years old on September 25, and, with the exception of the Roadmasters' Association, is the oldest railway maintenance of way organization in existence. Our association was more than seven years old when the preliminary meeting for the organization of the American Railway Engineering Association was held in Chicago, and nine years old when the first annual convention of that association was held on March 14, 1900.

On September 25, 1891, a representative group of bridge and building men met at St. Louis, Mo. for the purpose of organizing the association under the name of The American International Association of Railway Superintendents of Bridges and Buildings. The original title of the association was changed in October, 1894, to The Association of Railway Superintendents of Bridges and Buildings, and again in October, 1907, to The American Railway Bridge and Building Association. H. M. Hall of the Ohio and Mississippi acted as temporary chairman at the initial meeting, and C. W. Gooch of the Des Moines and Northern, as temporary secretary. The officers of the association elected at this meeting were as follows:

O. J. Travis, President, Iowa Central, Marshalltown, Ia.

H. M. Hall, First Vice-President, Ohio & Mississippi, Olney, Ill.

J. B. Mitchell, Second Vice-President, C. C. C. & St. L., Indianapolis, Ind.

James Stannard, Third Vice-President, Wabash, Moberly, Mo.

G. W. Hinman, Fourth Vice-President, Louisville & Nashville, Evansville, Ind.

G. W. Gooch, Secretary, Des Moines & Northern, Des Moines, Ia.

Geo. M. Reid, Treasurer, Lake Shore & Michigan Southern, Cleveland, Ohio.

Executive Members

W. R. Damon, Louisville, Evansville & St. Louis, Huntingburg, Ind.

G. W. Markley, C. C. C. & St. L., Crawfordsville, Ind.

W. A. McGonagle, Duluth & Iron Range, Two Harbors, Minn.

G. W. McGehee, Mobile & Ohio, Okolona, Miss.

G. W. Turner, St. Louis & San Francisco, Springfield, Mo.

J. E. Wallace, Wabash, Springfield, Ill.

The membership of the association at the time of its organization consisted of 60 members representing 40 railroads.

First Committee Reports

The first committee reports presented by the association were at its second meeting, held at Cincinnati, Ohio, October 18 and 19, 1892. Six committee reports were presented at this meeting, as follows:

(1) Painting iron bridges

(2) Framing and protection of Howe truss and other wooden bridges against fire and decay
(3) Surface cattle guards
(4) Interlocking signals
(5) Iron and vitrified pipe for waterways
(6) Water supply — which included a monograph on the subject of track pans by Geo. W. Andrews of the Baltimore and Ohio.

As my friend with the brown derby would say, "this is off the record" — the American Railway Engineering Association, nearly 40 years later, tried for ten years to get a report on this last subject.

These reports, even at the beginning of the association, covered problems that are still fundamental at the present time. It is interesting to note that the reports and papers read at this second meeting of the association were quoted widely in technical journals, not only in this country but in Europe as well.

It was brought out at this meeting that some of the committee members were working under the impression that the reports should comprise the opinions of individual members, rather than the results of a thorough investigation. This impression caused but little confusion, however, and resulted in convincing the membership of the necessity for united and concentrated efforts. That this was achieved is indicated by subsequent reports of the association.

Need for Organization

The founders of our association, were impressed with the belief that there was a need for an organization of this kind where they could meet and exchange ideas borne of their combined knowledge and experience, and in this communion of ideas, help to insure the advancement of knowledge pertaining to the design and construction of railway bridges, buildings and other structures.

The purpose which inspired these men to found our association can best be epitomized by Joyce Kilmer's poem, "The Bridge Builder":

An old man, going a lone highway,
Came at the evening, cold and gray,
To a chasm vast and deep and wide,
The old man crossed in the twilight dim,
The sullen stream had no fear for him;
But he turned when safe on the other side
And built a bridge to span the tide.
"Old man," said a fellow-pilgrim near,
"You are wasting your strength with building here;
Your journey will end with the ending day,
You never again will pass this way;
You've crossed the chasm deep and wide;
Why build this bridge at even'tide?"
The builder lifted his old gray head—
"Good friend, in the path I have come," he said,
"There followeth after me today
A youth whose feet must pass this way,
This chasm that has been as naught to me,
To that fair-headed youth may a pitfall be;
He, too, must cross in the twilight dim—
Good friend, I am building this bridge for him!"

Early Members Recalled

No better tribute could be paid the association than is contained in remarks made by W. A. McGonagle, president of the Duluth, Missabe and Northern, a past-president of the association and one of its charter members:

"I well remember the day that this association was organized in St. Louis, in 1891. We singled each other out in the hotel the day we arrived and it was only a short time before warm friendships were made that have lasted throughout our lives. I feel sure that all those who have gone on before will meet and greet us when we too have passed into the 'Great Beyond.' I remember our first president, O. J. Travis, who was not only a splendid type of a man, but who was also a very competent presiding officer and who displayed excellent judgment in the selection of the committees. He was ably assisted during the first year in getting the organization on a firm footing in having C. W. Gooch as its first secretary. I might say that Mr. Gooch is still living, and, after searching the records, as far as I can find, he is the only living charter member of the association. None of the older members will ever forget Joseph H. Cummin, who was a regular attendant at our earlier conventions and who always gave the opening prayer in a manner even better than could an ordained minister of religion.

"Then there was Walter G. Berg of the Lehigh Valley, a scholar of the highest type and a courteous gentleman at all times. J. E. Wallace was another practical man whose personal friendship we all enjoyed. The Markleys were friendly men, very competent in their profession and a joy to us at all times, inside, as well as outside the convention hall. Johnny Bull and Johnny Reb, whose real names were A. E. Killam and C. W. Vandegrift, will long be remembered as furnishing a lot of pleasantries at the conventions. They were given these names by Joe Cummin, who never tired of giving them plenty of publicity on all occasions. Then there was W. M. Noon, known as "High Noon" on account of his size. He and his good wife came to our conventions as long as they were able to travel and were a source of joy and happiness to us all.

"Last, but not least, was dear old Deacon Patterson, whose real name was Samuel F. Patterson. He looked like a preacher, dressed like a preacher, and could eat chicken like a preacher, but he was a jolly good fellow and kept our minutes as secretary for many years in a manner thoroughly satisfactory to all our members.

"There were many others who attended our early conventions, among them George Reid, B. F. Pickering, Geo. W. Andrews, W. S. Danes, John Foreman, C. M. Large, J. B. Sheldon, H. M. Hall, M. Riney, W. O. Eggleston, W. A. Rogers, Onward Bates, F. E. Schall and other too numerous to mention, who established the character and strength of our association and led us during their lifetimes, until we attained the strong position we now occupy as the hardest working and most practical of railroad associations. May we ever continue to occupy this strong position, and may we give due credit in the future, as we have in the past, to those pioneers who led the way into the successful career that we are now enjoying, and which has been of great benefit to the people at large in providing a safe roadway upon which they must travel as they wend their way from ocean to ocean, and even beyond the seas.

"The old American International Association of Railway Superintendents of Bridges and Buildings, was a very substantial stepping stone for me as I struggled along in railroad service, and I give much of the credit for my advancement in the service to the early lessons of thoroughness and practicability that I learned from my associates as I worked with them, to help build up this splendid organization. May God's richest blessings accompany each and all of you as we finish our convention work and as we travel to our homes in various parts of the country, and may He again bring us together in health and strength, to enjoy each other's companionship in the conventions yet to come."

Founded on Sound Principles

The result of the work of the association during the last 50 years indicates that it was founded upon sound principles. In looking back over the proceedings which comprise the work of this association, one cannot help but be impressed with the immense amount of work accomplished. There has been a remarkable advancement in railway structures during the last half century, in the development of which this association has taken no small part.

The membership of the association is now 610, as compared with a membership of 60 in 1891. The number and scope of the reports presented show a corresponding increase in the variety of subjects discussed and in the value of the information published. The various reports as published year by year cover a wide field dealing with all branches of bridge, building and water service work and are generally accepted as text books of concise and practical information pertaining to the subjects covered.

Contact of the association with manufacturers in the field has always been pleasant and harmonious. This exchange of ideas between the members of this association and the manufacturers has gone far toward the developments that have taken place in the materials, methods and up-to-date equipment used in bridge and building work.

The committee report on Strength of Bridge and Trestle Timbers as presented at the New Orleans convention, October 15-16, 1895, is probably the outstanding report of this association, and supplied information that was badly needed, as such information was not available prior to the presentation of this report. It was the first attempt to combine such information as was available at that time into a comprehensive report. The report included tables summarizing available data as to the strength of timber. These tables were compiled by Walter G. Berg, chief engineer of the Lehigh Valley and chairman of the committee. The report stimulated interest in this important subject and marked the beginning of further tests which were and are being followed by the U. S. Forest Products Laboratory and the U. S. Bureau of Standards.

Volume 23 in 1913 contains what is one of the first and most comprehensive reports on the construction and maintenance of track scales. This report included a historical review of weights and measurements dating from illustrations of the process of weighing found on the temple walls of Egypt in the time of Rameses. Other reports on foundations, and on the erection and testing of scales appeared in the Proceedings in 1894, 1895 and 1900.

The reports that have been presented on water service give consideration to almost every phase of the subject. The reports on railway water tanks 1915 and 1918 are considered text books on this subject as they contain more information than can be found anywhere else on the design, construction and maintenance of water tanks for railway service.

No other association has followed the question of painting and paint for railway structures more closely than our association. No less than 21 reports have been made on painting. These reports have covered almost every phase of the subject, ranging from the fundamentals of paint manufacture to the most modern methods of application.

Reports on the subject of railway buildings have been largely from the standpoint of maintenance rather than design. However, a perusal of the proceedings will show that this important subject has been by no means neglected. Particular attention within the last few years has been given to the reconstruction and modernization of existing facilities.

The association has kept pace with progress in the mechanization of maintenance and construction forces. The report on the use of mechanized tools on the Bonnet Carre spillway, in 1934, and on the mechanization of bridge and building forces, in 1940, are examples of the work along this line.

It is necessary to follow the work of the association throughout its 50 years of life in order to realize the progress made in the branches of railroad service represented by this organization. These years have produced many changes in both materials and methods. When this association was organized, there were few instances where a bridge load called for more than Coopers E-35, while present bridge loadings are perhaps more than double those of 50 years ago. Steel was substituted for wrought iron in girder spans and trusses during the first few years of the association; the Howe truss, which played such an important part in the early history of our association is but a memory; concrete has displaced completely the stone and rubble masonry used almost universally in the early Nineties; the United States consisted of 44 states and five territories in those days; the total railroad mileage was a little over 150,000 miles; and the tonnage of trains averaged around 182 tons per train. Fifty years of progress has brought the railway mileage up to over 240,000 miles, while the average train tonnage is now 952 tons.

To quote from another past-president of the association—"Through all the transformation, all the evolution, the association remains today unchanged in the fundamental objects and principles for which it has always stood. Any institution which can prevail through so long a period of incessant and radical change compels more than passing notice. It must be worth while. The high purpose and noble ambition of the individual in duty well done can alone render enduring any composite organization such as this, and thus has the association grown and prospered. Well may we be proud of the enviable position this society occupies."

Although we can well be proud of the work of the association and the position it occupies in the railway field today, our work is not finished; it is hardly begun. Although progress and development during our 50 years of existence have been remarkable, they are but little as compared with what we may expect in the future. The coming years promise even more and more progress, with which we must keep pace if we are to keep up with the procession of time. We have little to fear, however, if we will follow the same spirit of loyalty and devotion to duty which has been the outstanding characterstic of the membership of this association throughout the last 50 years.

Pictures of Early Convention Groups

Before proceeding further, I would like to show some slides, Mr. Operator, please. We have a few slides which have been taken from our "Family Album," which some of you older members will recall we used to run from time to time a few years ago. I will try to explain the slides, in part, at least, as we go along.

This first slide merely illustrates the cover of the first Proceedings of the association.

This is a picture of Mr. Travis, the first president of the association.

This is a picture of "Deacon" Patterson. "Deacon" Patterson served as our secretary for 17 years. I would dwell on "Deacon" Patterson at considerable length, because I think he was perhaps the most colorful member of this association.

"Deacon" Patterson served as our secretary for 17 years. "The Deacon" began his railroad career as a bridge builder on the Concord and Montreal Railroad before the Civil War, and except for his service during that war he served that company and its successor, the Boston & Maine, for 50 years. "The Deacon" enlisted as a private in Company B, 2nd New Hampshire Volunteer Infantry, September 7, 1861, and served his full enlistment of three years. After reenlistment in 1865, he was made first lieutenant in Company C of the same regiment. He fought at Seven Pines, Gettysburg and other important engagements in the War Between the States. Following the passing of "The Deacon" in Chicago, April 7, 1917, his friends in the association raised by popular subscription funds for a memorial block and tablet which were placed upon his grave at Concord, N. H.

This is a photograph of Mr. Markley, one of the early members of the association. I believe he was one of the charter members, was he not, Mr. Howson?

Mr. Howson: Very close to it.

Mr. Knowles: I guess you all know this fellow. This is George Rear of California.

This is J. M. Gauthier, who was one of our officers for a number of years, and who died just before entering upon his term as President. He had just been elected to that office.

This is a group of old timers. I think that is a North Western group. I see Jim Robinson, Cal. Lichty and a few others there.

This is another bunch of old timers, Cal. Lichty, Jim Robinson, W. F. Strauss and others.

This is another group. I think this was taken at the Atlanta convention, at Chickamauga park. I recognize Fred Weise.

This is, I believe, Johnny Reb and Johnny Bull. They were two more colorful fellows. Johnny Bull is on the left. That is Mr. Killam and Mr. Vandergrip.

This is a picture made in Cincinnati, in 1922.

I think this picture was, perhaps, taken at Richmond, Va. At any rate, you will notice the two charming young men in the front row. They were known as the Gold Dust Twins, I believe, Tom Lehon and John Nelson. Poor John is gone, but I think Mr. Lehon is here tonight. There is also L. D. Hadwen.

This is O. J. Travis, they tell me. I guess I got mixed up on the first one. The other one I think was Mr. Gooch.

This is another group. I don't recall just where this picture was taken, but it was on one of our various trips. I asked Mr. Howson where that was. He said he didn't know but that it was when women were women and wore dresses to their shoetops. (Laughter)

This is another picture. There is Cal. Lichty and Mr. Lamond of the Southern, George Andrews of the B. & O., Fred Weise, Bob Reed of the New York Central. Mr. Lamond is still living.

This picture was taken at Atlanta, Ga., at that famous barbecue we had out there—the Brunswick Stew and Barbecue. That is Stone Mountain in the background. There is Mr. Waterman, of Birmingham, the second from the left in the first row.

This is another group picture. I seem to recognize John Wood of the Pere Marquette in the background.

This is another group. I don't know that I recall just where that was made. I see Mr. Scowden at the extreme left. He just passed away a short time ago.

Member: That was taken at a treating plant, I believe, Mr. Knowles.

Mr. Knowles: This is a North Western group. There is Mr. Case at the extreme right; Cal. is the fourth from the extreme left.

Here is another group. I don't recall where that slide was taken. (Members say, in front of a barber shop.) It might have been a planing mill.

Mr. Knowles: Here is another one. The handsome gentleman on the extreme right, with the Arrow collar, is Walter Lacher. The next to the right, I think, is Elmer Howson.

And now, ladies and gentlemen, if you will indulge me for just a few minutes longer, I would like to quote as an epilogue, and also as a tribute to our founders who have gone on before, Kipling's "L'Envoi":

"When Earth's last picture is painted, and the tubes are twisted and dried,
When the oldest colors have faded, and the youngest critic has died,
We shall rest, and, faith, we shall need it—lie down for an aeon or two,
Till the Master of All Good Workmen shall set us to work anew!

And those that were good shall be happy, they shall sit in a golden chair;
They shall splash at a ten-league canvas with brushes of comet's hair;
They shall find real saints to draw from—Magdalene, Peter, and Paul;
They shall work for an age at a sitting, and never be tired at all!

And only the Master shall praise us, and only the Master shall blame;
And no one shall work for money, and no one shall work for fame;

But each for the joy of the working, and
each, in his separate star,
Shall draw the thing as he sees it, for
the God of things as they are!"

Mr. Howson: We hope that those of you who have come into this organization in recent years have been interested in the pictures of the years that have gone—the pictures of some of the men who individually are known to a number of us. I was very much interested in the comments of Maro Johnson, who was calling off the names of some of these men—I think it was Maro. I am sure that it took him back to the days when he saw those men behind these desks presenting the committee reports. As I looked at those faces and realized how almost universally they have passed on, it made me think of an experience that Tom O'Leary had last summer. While he was driving out through the West, he came into a small off-the-railroad town and stopped at a filling station to replenish his supply of gas. There was an old timer sitting there and Tom took a look at him and said, "Mister, have you lived here all your life?"

The old timer replied, "Not yet."

I think that is the status of our association today—not yet. We are still on our way.

One of the men who goes way back in our association, as far as, or probably further than Mr. Knowles and I—and I think we go back about as far as anyone here —is Tom Lehon. Tom, please stand up, some of the youngsters may not know you. (Applause) And I think Mr. Thulin goes way back. Are there others here who go back to those days and whom we might just recognize with a word of greeting?

Motion Picture of Tacoma Narrows Bridge Failure

Mr. Howson: We have another event tonight for you. We plan to show you something we think is one of the most remarkable things that has happened in our generation. There was a very interesting bridge built a couple of years ago out in the Puget Sound territory, and there was a very remarkable failure of that bridge. That bridge was unique in its design; in fact, rather venturesome, and its design was watched with some concern by certain bridge engineers. After the bridge was completed and placed in service, it was watched with even more concern.

In operation, under winds, the bridge started a swaying motion. In fact, this motion gained such proportions that it was nicknamed "Galloping Gertie." Then, ultimately, when a higher than normal, quite an extraordinary wind developed, the bridge collapsed. The record of this failure has been brought to us in pictures because there were those venturesome people, engineering-minded people, who made a record of it. In this picture, you will see an automobile on that bridge. As a man drove out on the bridge in his automobile, it began its extreme motions, which became so violent that the man deserted the car and started to run to one end of the structure. A dog which the man had with him in the car became so frightened that he couldn't get it out of the car. The dog refused to leave. The man was thrown off his feet by the motion of the bridge and had to crawl part of the way to get off. He got off safely, but the automobile and the dog went down with the bridge.

I am sorry we don't have the story of the bridge, and yet, if the story was narrated to you, it would take more time that we felt was available. However, through the courtesy of the American Society of Civil Engineers, we have the film. Those of you who have built bridges and who have not seen this film, I think will be intensely interested in it, and in the distortion to which the Narrows bridge was subjected before finally collapsing. We will now have the "Galloping Gertie" film.

. . . The film was shown at this point and proved of great interest to all those present.

Meeting recessed at 9:35 p.m.

Morning Session

Wednesday, Oct. 15, 1941

The session was called to order at 10 a.m., President Church presiding.

President Church: We will call the morning session to order and take up first the report of the Committee on Off-Track Equipment, the discussion of which was postponed yesterday and which will now come up as unfinished business. If there are members of this committee here, we would like to have them come to the platform.

(The discussion of this report will be found on page 75.)

President Church: The mechanization of bridge and building forces is of comparatively recent origin, and the proper care of machines and equipment is a major problem confronting maintenance officers. We are now to have a report on the Maintenance and Repair of Bridge and Building Equipment. This report will be presented by Martin Meyer, committee chairman, and supervisor of bridges and buildings of the Chicago & Western Indiana. I should like Mr. Meyer and his committee to come forward.

. . . Mr. Meyer then read the report (See page 96).

President Church: The modernization of railway stations has developed many innovations, and the application of new materials to small stations is especially interesting to all concerned in railway operation and maintenance. The subject of modernizing small stations to meet present-day requirements will be presented to us by L. C. Winkelhaus, chairman of this committee, who is architectural engineer of the Chicago & North Western, here in Chicago. Mr. Winkelhaus and the members of his committee will please come forward at this time.

. . . Mr. Winkelhaus then read the report (See page 107).

Mr. Church then introduced A. O. Lagerstrom, architect of the Chicago, Milwaukee, St. Paul & Pacific, who presented an address on Railway Buildings in a Changing Age. (See page 117.)

President Church: We have a very interesting luncheon ahead of us, as you have noted on your program, and one which should attract considerable attention. The speaker on this occasion is a representative of the Federal Bureau of Investigation. He is Mr. E. P. Coffey, one of the principal assistants to J. Edgar Hover, who had expected to be here to acquaint us with the new problems with which we may be confronted under this national emergency. Mr. Coffey is the Chief of the Technical Laboratory at Washington, D. C., and this, in itself, implies a basic foundation for a most interesting address. It should be profitable to all of us.

. . . Recessed at 11.50 a.m.

Annual Luncheon

Wednesday, Oct. 15, 1941

President Church: Members and guests of the American Railway Bridge and Building Association:

It is a pleasure to welcome you to our annual luncheon this year. We have a much larger attendance than usual. It is reported there are about 304 persons here. We have with us as guests, at the Speakers' table, executive officers from most of the railroads centering in Chicago, and I would like Mr. Howson to introduce them to you.

E. T. Howson: We are greatly indebted to these executives of the railroads centering in Chicago who have joined with us at the luncheon today to express their interest in the work of this organization. I will introduce them in the order in which they are seated at the speakers' table, and it will expedite matters if you will withhold applause until after they have all been introduced.

Those who are members of the association know A. E. Bechtelheimer, engineer of bridges of the Chicago & North Western Railway, and the president of this association last year.

G. Metzman, assistant vice-president of the New York Central Lines, Chicago.

A. M. Knowles, assistant engineer of structures of the Erie and vice-president of the Bridge and Building Association.

T. D. Beven, vice-president of the Elgin, Joliet & Eastern.

F. H. Soothill, chief estimator of the Illinois Central, and second vice-president of the Bridge and Building Association.

C. E. Johnston, chairman of the Western Association of Railway Executives and a long-time friend of this organization.

L. L. White, chief operating officer of the Chicago & North Western System.

R. E. Dove, assistant engineer of the Chicago, Milwaukee, St.

Paul & Pacific and first vice-president of this organization.

F. L. Thompson, vice-president, engineering, Illinois Central System.

G. S. Crites, division engineer of the Baltimore & Ohio and vice-president of the Bridge and Building Association.

C. E. Smith, vice-president in charge of purchasing of the New York, New Haven & Hartford, and a past-president of this association, who has maintained his interest in the organization throughout the years as he has been advancing through the railway ranks.

Clarence R. Knowles, past-president of this association and superintendent of water service of the Illinois Central System.

F. O. Whiteman, secretary of the Bridge and Building Association.

. . . President Church here introduced E. P. Coffey, Chief of the Technical Laboratory of the Federal Bureau of Investigation. (For Mr. Coffey's address see page 119.)

Afternoon Session

Wednesday, Oct. 15, 1941

The meeting was called to order at 2:20 p.m., President H. M. Church presiding.

President Church: The first order of business will be a report from our Nominating committee, so that the members here may have a chance to review it. Mr. Burpee, chairman, will give the report.

Report of Nominating Committee

C. M. Burpee: Before presenting the report of the Nominating committee, a few explanatory remarks are necessary regarding the situation that faced the committee this year. May I read a communication from the secretary, dated at Chicago, September 19, 1941, addressed to President H. M. Church?

Mr. H. M. Church, President
American Railway Bridge and Building Association

I have severed my connection with the Roadmasters' Association, but at their request, will serve as acting secretary until January 1, 1942.

I should like to continue as secretary of the B. & B. Association, however, to make matters easy for you, and to avoid any possible embarrassment, you may consider this as my resignation as secretary of the B. & B. Association, to take effect at your pleasure. I am putting it that way, so that if you wish to continue the arrangement of having a joint secretary with the Roadmasters' Association, the way is open for you to negotiate with them to secure a man who will be mutually satisfactory.

Signed:
F. O. Whiteman,
Secretary

Mr. Burpee: Following the receipt of this letter, the president appointed a special committee with Mr. Dove as chairman, to handle the matter and to report directly to the Nominating committee. The next communication I shall read to you is that of Mr. Dove, reporting as chairman of the Special committee, addressed to me as chairman of the Nominating committee, dated at Chicago, October 8.

Mr. C. M. Burpee, Chairman,
Nominating Committee
American Railway B. & B. Assoc.,
Chicago, Ill.

Dear Sir:

Under date of September 19th, President Church received a letter of resignation from Secretary Whiteman, and on September 22nd, he appointed a Special committee consisting of Mr. Soothill, Mr. Weise, Mr. Bechtelheimer and the undersigned.

On September 27th, Mr. Church appointed a Nominating committee, with you as chairman, and in his letter of appointment he instructed the Special committee to report directly to the Nominating committee.

Pursuant to this instruction, I wish to advise that the Special committee is unanimous in accepting Mr. Whiteman's resignation.

The Special committee further recommends the name of Mr. A. G. Shaver for nomination as secretary.

Mr. Shaver is a consulting engineer with an office in the Straus building here in Chicago. He employs a stenographer who will be helpful to him in handling the detail work of the association. He is a man 66 years of age and was formerly signal engineer of the Rock Island. Also, he is not a stranger to association work as he has been active in the Western Society of Engineers for many years.

Yours very truly,
R. E. Dove,
Chairman, Special Committee

Mr. Burpee: With that brief preface, I may now present for your consideration the report of the Nominating committee.

We, the undersigned, having been duly appointed as members of the Nominating committee, do hereby place in nomination the names of the following men, who, in our opinion, are best fitted to undertake the responsibilities of their respective offices during the coming year 1941-42.

For President; R. E. Dove, (C. M. St. P. & P.).

For 1st Vice-President, F. H. Soothill (I. C.).

For 2nd Vice-President: G. S. Crites (B. & O.).

For 3rd Vice-President: A. M. Knowles (Erie).

For 4th Vice-President: N. D. Howard (Ry. Eng. & Mtce.).

For Secretary, A. G. Shaver.

For Treasurer: F. E. Weise (C. M. St. P. & P.).

I should also like to call your attention to the fact that of our six Directors, three have terms expiring this year. The other three, having been elected for two years, and, having served but one, will continue in their present capacities. The men whose names we are placing in nomination as Directors for full two-year terms follow:

Martin Meyer (C. & W. I.)
L. E. Peyser (S. P.)
J. L. Varker (D. & H.)

Signed:
C. Miles Burpee, Chairman
C. R. Knowles
Armstrong Chinn
T. H. Strate
Elmer T. Howson

President Church: You now have the report of the Nominating committee before you for your consideration. This report will be acted upon in the regular course of business at the closing session tomorrow, so you will have plenty of opportunity for full consideration of those who have been selected to further the work of our association in the year to follow.

Reads Letter from Treasurer F. E. Weise

President Church: I would like to take this opportunity to read a communication received from our treasurer, F. E. Weise.

Dear Mr. Church:

Herewith the treasurer's report for the year ending September 30, 1941. Am sorry that I am not able to present it at the convention personally.

Mr. Dove has explained the situation to you and you may be sure it is a great disappointment as I have been looking forward to an unusually interesting meeting.

Please extend my greetings to the members of the association and best wishes to you.

Yours sincerely,
F. E. Weise

. . . President Church then introduced C. E. Smith, vice-president, in charge of purchases and stores of the New York, New Haven and Hartford, who addressed the meeting on the Effect of the Defense Program on the Procurement of Railroad Materials. (For Mr. Smith's address, see page 126.)

. . . President Church then introduced A. G. Haggander, assistant chief engineer of the Chicago, Burlington & Quincy, who spoke on What We Can Do in the Face of a Shortage of Materials. (For Mr. Haggander's address see page 141.)

. . . The meeting was recessed at 4 p.m.

The Annual banquet of the association was held on Wednesday evening, jointly with the Bridge and Building Supply Men's Association, and was attended by 222 persons.

Morning Session

Thursday, Oct. 16, 1941

The session was called to order at 9:45 a.m., President H. M. Church presiding.

President Church: The first order of business this morning is a continuation of our committee reports. Water service on the railroads has been in an active state of development for many years, and the recent improvements in welding have permitted its application to maintenance and construction in this field to a considerable extent. The report of the Committee on Welding in Water Service will be presented by J. P. Hanley, water service inspector on the Illinois Central, chairman of the committee. G. S. Crites, division engineer of the Baltimore and Ohio, is vice-chairman of the committee. We will be glad to have these gentlemen and the members of their committee come to the platform.

. . . Mr. Hanley then read the report (See page 148).

President Church then introduced A. B. Pierce, engineer of water supply of the Southern, who spoke on Modernizing Water Facilities to Meet the Demands of Modern Train Operation. (For Mr. Pierce's address see page 169.)

President Church: Under present trying conditions, when it is difficult for men to get away from their work to come to our convention, it is interesting to note that we have an attendance this year of 210, including guests, which is within 12 of the number present last year.

The conditions under which road and terminal forces employ equipment to better advantage, with more economy than usual, and the precautions being observed to avoid losses, provide a very interesting subject for consideration at this time. A report on Efficient Methods of Transporting Bridge and Building and Water Service Gangs has been prepared by a committee, of which S. S. Long, division engineer of the Chicago & North Western, is chairman, and I invite him and his committee to come forward to present the report at this time.

. . . Mr. Long then read the report (See page 159).

President Church: We will now stand adjourned until 2 p.m.

. . . Recessed at 12:15 p.m.

Afternoon Session

Thursday, Oct. 16, 1941

The final session of the convention was called to order at 2:05 p.m., President Church, presiding.

President Church: We will now take up the regular order of the program. Now that the era of new construction has waned and we are well into the era of maintenance and preservation of what we have, little is more important that the technic of painting, particularly as applied to steel structures. Experience has shown that in successful painting, the preparation of the surface is the most important item. A report on this subject has been prepared by a committee of which C. Miles Burpee is chairman. Mr. Burpee is one of our past-presidents and is at the present time Managing Editor of Railway Engineering & Maintenance Cyclopedia. Will Mr. Burpee and the members of his committee come to the platform and present their report?

. . . Mr. Burpee read the report (See page 180).

Welcomes New Members

Just before you leave, gentlemen, we would like to know how many new members are present in the meeting at this time. Will any new members here please stand and give your names? (The new members present stood and gave their names.) Thank you, gentlemen. (Applause.) We are glad to welcome you here and we hope you will feel free to join our committees and get into our work. You have had your first initiation here, and we certainly appreciate your staying through this meeting.

Convention Reviewed

President Church: We are introducing a new feature in our program this year in the form of a Summing Up address, highlighting the more important facts that have been brought out in the reports and addresses presented before us during the last three days. We are particularly fortunate to have Armstrong Chinn, one of our past-presidents, present this address, and it is a special pleasure for me to turn the meeting over to him now. Mr. Chinn.

(For Mr. Chinn's summary, see page 194.)

Business Session

President Church: We will now proceed with our business meeting and have the report of the secretary.

Secretary's Report

			Total Sept. 30, 1941
Active members, Oct. 1, 1940		491	
New members added		50	
		541	
Transferred to life membership	3		
Died	3		
Resigned	22		
Dropped	27	55	
		486	486
Associate members Oct. 1, 1940		23	
New members added		1	
		24	
Dropped		5	
		19	19
Life members, Oct. 1, 1940		95	
Transferred from active list		3	
		98	
Died	4		
Dropped (mail returned)	6	10	
		88	88
Honorary members, Oct. 1, 1940		1	1
Total membership, Sept. 30, 1941			594
Total membership, Oct. 1, 1940			610
Loss during the year			16

President Church: You have heard the report of the secretary. It shows that we will be confronted with considerable work to maintain our membership during the coming year. We must depend on all of you members, as stated by Mr. Chinn, to go back home and help in this work.

We will now have the report of the treasurer.

R. E. Dove (C. M. St. P. & P.): Gentlemen, our treasurer, Mr. Weise, is ill and unable to attend the convention. I have been asked to present his report.

Treasurer's Report

Cash balance, October 1, 1940, as per audit		$ 519.68
Receipts:		
Dues	$2,082.05	
Advertising	490.00	
Literature sales	21.50	
Bank dividend	26.35	
Miscellaneous	38.05	2,657.95
		$3,177.63
Disbursements:		
Salary	$ 594.00	
Stationery and printing	1,354.95	
Office supplies	16.60	
Postage	77.15	
Convention expenses (1940)	180.07	
Convention reporter (1940)	119.40	
Bad check	4.00	
Exchange and discount	4.79	
Social security tax—employer	9.60	
—employee	6.00	
Bonding secretary and treasurer	22.50	
Refund to estate of C. A. Lichty	105.40	
Engrossing membership certificates	6.24	
Miscellaneous	15.83	2,516.53
Cash balance, September 30, 1941		$ 661.10

Reconciliation:

Bank balance, Sept. 30, 1941	$586.10
Undeposited receipts	75.00
	$661.10

Signed—F. E. WEISE, Treasurer

President Church: The report will be received as read, unless there is objection.

We will now have the report of the Auditing committee, by T. H. Strate, division engineer of the Milwaukee.

Report of Auditing Committee

We, the undersigned members of the Auditing committee have examined the books of the secretary and of the treasurer for the fiscal year, October 1, 1940, to and including September 30, 1941, and have found them to be correct as of the latter date.

Signed:
T. H. Strate, Chairman,
J. P. Hanley,
Geo. E. Boyd,
R. P. Luck,
M. Meyer,
F. O. Whiteman.

President Church: If there are no objections, this report will be made a part of the record.

Subjects Committee

President Church: The report of the Subjects committee is the next to be presented. This is a very important report and I suggest that you take particular note of the subjects suggested and be prepared to help on next year's program. The report will be presented by Mr. Dove.

Mr. Dove: It has been gratifying to note the discussions following the reports at this convention, which highly justify the subjects selected by your Subjects committee last year. In the selection of subjects for the next year, you will note that it has been found expedient to continue one of the subjects for the last year, which was not reported on at this convention.

Your Committee on Subjects suggests the following subjects for investigation and study by the association during the next year and recommends that they be referred to the Executive committee for approval—

(1) Wearing surfaces for building floors, platforms and roadways.
(2) Rail fastenings on bridges, pits and turntables.
(3) Meeting the demands for increased water supplies in fast freight service.
(4) Preventing accidents among bridge and building employees.
(5) The repair of steel bridges.
(6) The conservation of bridge, building and water service materials.
(7) Piles and pile driving.
(8) The cleaning of masonry buildings.

Signed:
R. E. Dove, Chairman,
A. E. Bechtelheimer,
R. E. Caudle,
G. S. Crites,
K. L. Miner,
I. M. Moore.

Armstrong Chinn: Mr. President, the Subjects committee has done an excellent job and I move that we accept the subjects as presented.

G. S. Crites (B. & O.): I second the motion.

President Church: You have heard the motion and its second. All in favor, say "Aye." Contrary, "No." It is so ordered.

Resolutions Committee

President Church: We will have the report of the Resolutions committee, by Neal Howard.

N. D. Howard: It has been a pleasure for your committee to draw up the following resolutions expressing the appreciation of the association to the many who have labored and co-operated so earnestly during the last year in its behalf, and we know that it will be an equal pleasure for you to adopt these resolutions for publication in the 1941 Proceedings.

RESOLUTIONS

Our forty-eighth annual convention has added new achievements to the long and constructive accomplishments of our association. The value of the work that has been done during the last year, and the deliberations of our annual meeting, will go far beyond this meeting room and be of interest and benefit to bridge, building and water service men scattered widely over the railways of this country and Canada — aiding them in the solution of their ever-changing and ever-increasing problems.

That our convention this year has been such a successful one did not just happen. On the contrary, it has been the result of hours of planning, arduous work and closely co-ordinated effort on the part of the officers of the association, many of its members, and other individuals and organizations far too numerous to make it possible to make individual acknowledgment to all of them here. It is, however, proper and fitting that we, as an association, at this time, express our sincere appreciation to at least those who have contributed most largely, in one way or another, to the success of our convention.

Be it resolved, therefore, that in convention assembled, we express our appreciation to the following individuals, committees, organizations and companies for their efforts and co-operation throughout the year just passed:

To those railway executives and other railway officers who have shown a keen interest in the work of our association and who have encouraged and made it possible for so many of our members to be present at this meeting.

To Dr. Harrison Ray Anderson, pastor of the Fourth Presbyterian Church, Chicago, for the invocation offered at our opening session on Tuesday.

To M. J. Gormley, executive assistant of the Association of American Railroads, for his informative and challenging opening address.

To H. R. Clarke, vice-president of the American Railway Engineering Association; A. B. Hillman, president of the Roadmasters' and Maintenance of Way Association; and C. C. Rausch, president of the Bridge and Building Supply Men's Association, for the greetings and best wishes which they brought from their respective associations.

To Messrs. C. E. Smith, vice-president of the New York, New Haven & Hartford; P. O. Ferris, chief engineer of the Delaware & Hudson; A. O. Lagerstrom, architect of the Chicago, Milwaukee, St. Paul & Pacific; G. A. Haggander, assistant chief engineer of the Chicago, Burlington & Quincy; and A. E. Pierce, engineer of water supply of the Southern, for the interesting and constructive addresses which they made during the course of our meeting.

To E. P. Coffey, chief of the Technical Laboratory of the Federal Bureau of Investigation, for his timely, enlightening and thought-provoking address at our annual luncheon on Wednesday.

To Past-President C. R. Knowles, superintendent of water service of the Illinois Central System, for his able conduct of our Golden Anniversary celebration on Wednesday evening, and his comprehensive review of the association's activities during the last half century.

To the American Society of Civil Engineers for its courtesy and co-operation in the loan of its films of the collapse of the Tacoma Narrows Bridge.

To Past-President Armstrong Chinn, chief engineer of the Alton, for his able summary and highlighting of the convention activities at our closing session.

To the Pullman Company for its courtesy in extending half-rate privileges to members and their families in traveling to and from the convention.

To the Bridge and Building Supply Men's Association, and to its members individually, for their many courtesies and the help they have contributed to the success of this meeting.

To Railway Engineering and Maintenance, and to its publisher, the Simmons-Boardman Publishing Corporation, for preprinting our reports, and for making available copies for use on the convention floor; and

To the officers and directors of our association and to the chairmen of its committees for the time and effort they have expended on the affairs and work of the association during the last year.

Signed:
N. D. Howard, Chairman,
F. W. Hutcheson
R. E. Caudle
S. S. Long
R. W. Cassidy

Mr. Howard: Mr. President, I move the adoption of these resolutions and their publication in the 1941 Proceedings.

President Church: May we have a second?

Mr. Chinn: I second the motion.

President Church: It has been moved and seconded—all those in favor, say "Aye." It is so ordered.

Mr. Howard: Mr. President, may I have the floor again for just a minute to make a correction, or an addition to the resolutions just read? In my report for the Committee on Resolutions, I omitted, I am sorry to say, acknowledgment and thanks to Past - President Armstrong Chinn, chief engineer of the Alton, for his fine summary and highlighting of the convention activities at the close of our session. It is in the original report which you adopted, but I skipped right over it inadvertently when I read the report.

Report of Convention City Committee

President Church: We will now have the report of the Convention City committee, by F. H. Soothill.

F. H. Soothill (I. C.): Your committee appointed to consider the meeting place for the 1942 convention reports as follows:

In view of the uncertainties now confronting the railways and the many demands that are being made upon the time of our members, your committee on Convention City believes that a central location, easy of access, is essential. We, therefore, recommend that Chicago be selected as the headquarters for our convention in 1942.

Signed:
F. H. Soothill, Chairman
W. A. Sweet
C. R. Knowles
N. D. Howard

Mr. Soothill: I move the adoption of this report.

President Church: You have heard the motion. May we have a second?

Elmer T. Howson: I second the motion.

President Church: All in favor, say "Aye." It is so ordered.

Obituary Committee

We will now have the report of the Obituary committee, which will be presented by A. E. Bechtelheimer, one of our past-presidents.

A. E. Bechtelheimer (C.&N.W.): Mr. President and members of the association:—It would not be fitting to close this convention without paying tribute to those who will never meet with us again.

To the Members of the American
Railway Bridge and Building
Association:

Whereas, we have received notice since our last convention that death has removed from our roster and from further consideration of earthly affairs the following members:

Henry Bender — August, 1941; W. H. Cochran—January 9, 1940; Franklin Gable — July 22, 1940; A. J. James—February 14, 1941; L. C. Prunty—September 15, 1940; H. C. Stevens—February 11, 1941; George Loughnane—October, 1941; William Curtin — October, 1941; and S. C. Tanner—April 2, 1941.

[Mr. Tanner was president of this Association in 1917-1918. He was a tireless worker in association affairs and, during his active years, he was a recognized leader and active worker.]

Therefore, Be it Resolved, That the members of this association, in convention assembled, express their deep regret and sorrow for these losses, and that as an expression of condolence to their surviving relatives, who also mourn them, this resolution be spread upon and be made a part of the minutes of this meeting, and a copy be sent to the families of these deceased members.

Signed:

A. E. Bechtelheimer, Chairman
L. D. Hadwen
J. T. Hogan
F. E. Weise
G. S. Crites
L. E. Peyser

Mr. Bechtelheimer: I move the adoption of the report.

President Church: You have heard the motion. Is there a second?

L. C. Winkelhaus (C. & N. W.): I second the motion.

President Church: I suggest a rising vote in connection with the approval of this resolution. (All stand). It is carried unanimously.

Amendments to the Constitution and By-Laws

President Church: We will now have the proposed amendments to the Constitution and By-Laws, by the secretary.

Secretary Whiteman: These are the amendments recommended by the special committee appointed to investigate the question of junior membership. The Constitution and By-Laws were complied with by publication of the proposed amendments in the B. & B. News for the month of August.

PROPOSED CHANGES IN THE CONSTITUTION

Article III, Section 1 (As amended):

The membership of this association shall be divided into five classes, viz: Members, life members, associate, honorary and junior members.

Article III, Section 6 (as amended):

A junior member shall be a person who is a graduate of a recognized engineering school, or who has been employed for at least two years in the design, maintenance or construction of railway bridges, buildings or structures. Applicants shall be at least 21 years of age and they shall be elected in the manner prescribed for members, in Section 2 of this article. Juniors shall have all the rights of members except that of holding office. When the attainments of a Junior are such as to qualify him as a member, he may apply for promotion and the Executive committee shall authorize such promotion when qualifications warrant the action. Unless a Junior is promoted, his membership shall cease automatically when he becomes 28 years of age.

Article III, Section 6 (As amended) shall be renumbered Section 7.

Article III, Section 7 (As amended) shall be renumbered Section 8.

Article III, Section 8 (As amended) shall be renumbered Section 9.

PROPOSED CHANGES IN BY-LAWS

Section 5 of the By-Laws shall be amended as follows:

The annual dues, for the fiscal year ending September 30, and payable in advance, shall be as follows:

Members	$4.00
Associate Members	3.00
Junior Members	2.00

President Church: I will entertain a motion on the adoption of the amendments as read.

C. R. Knowles (I. C.): I move their adoption.

G. S. Crites (B. & O.): I second the motion.

President Church: All in favor, say "Aye." Opposed, "No." The amendments are adopted.

Election of Officers

President Church: We will now proceed with the election of officers:

Secretary Whiteman: The Nominating committee named the following for officers in its report read to the convention yesterday:

For President: R. E. Dove (C. M. St. P. & P.).

For 1st Vice-President: F. H. Soothill (I .C.).

For 2nd Vice-President: G. S. Crites (B. & O.).

For 3rd Vice-President: A. M. Knowles (Erie).

For 4th Vice-President: N. D. Howard (Ry. Eng. & Mtce.).

For Secretary: A. G. Shaver.

For Treasurer: F. E. Weise (C. M. St. P. & P.).

For Directors to Serve Two Years:

Martin Meyer (C. & W. I.)
L. E. Peyser (S. P.)
J. L. Varker (D. & H.)

President Church: You have heard the list of nominees as presented by the Nominating committee. Are there any questions in connection with these nominations?

Armstrong Chinn (Alton): I move that the report of the Nominating committee be accepted and that the secretary of the association be directed to cast the unanimous ballot of the association for the election of the nominees.

President Church: Is there a second?

R. E. Caudle (M. P.): I second the motion.

President Church: You have heard the motion and the second. All in favor, say "Aye." Carried.

Secretary Whiteman: The secretary casts the unanimous vote of the association for the officers and directors as named by the Nominating committee.

Installation of Officers

President Church: We will now have the installation of the new officers, which will be conducted by our Past-President Mr. Bechtelheimer.

Mr. Bechtelheimer: President Church, I think of this procedure as something very dignified and very impressive, and I am scarcely equal to either of those requirements. There are certain things that I would like to say, but that probably I shouldn't, and there are things that I should say that I probably won't—but if you will give me the list of nominations, I will get the new officers up here and we will go through with the installation.

I recall the time when I was inducted into my first office in the Bridge and Building Association—that of director. George Rear conducted the ceremony, and I don't believe I have to say any more to make you understand the kind of a ceremony that that was.

If the newly-elected directors, Martin Meyer, L. E. Peyser and J. L. Varker, will come and occupy these three chairs, I will appreciate it. And then I want the first vice-president, Mr. Soothill, the second vice-president, Mr. Crites, the third vice-president, Mr. Knowles, and the fourth vice-president, Mr. Howard, to come to the platform. — You may be seated, gentlemen. Now, I want Mr. Shaver, our new secretary, and Mr. Dove, our new president, to come to the platform. And Mr. Whiteman, I want you to come up right here.

Mr. Whiteman: I am not in this.

Mr. Bechtelheimer: Please come up and take this chair.

Now, Mr. Chinn, if you will come up here and back me up a bit, we will proceed.

There are a number of things I would like to say to you gentlemen. I believe that the membership of this association is not just a list of names, but that every man in the association is a friend and a fellow-worker, willing and anxious to serve as you officers may call upon him for specific work. As president, I found it impossible to keep away from a study of our membership. I felt that I could do little for the association, or less than I should, without actually, in some manner, getting some idea of each person on our membership list. I felt that he must become a friend of mine and I a friend of his; that I had to know something of him personally. And I warn you, Mr. Dove, Mr. Shaver, and all you other officers, that your success in conducting the affairs of this association will depend in large measure upon the attention you give to the group represented by its membership.

And you members of this association have equal responsibilities with your officers. There are many ways in which each of you can make yourselves known to your officers. I remember some of the most pleasant things that happened to me during my term as president consisted merely of a few words at the end of a letter; words, you might say, "off the record," that gave me an inkling of what I could expect from or could do with that member whom I had never seen and did not know. From just such little things I came to know many of you more intimately. And so I say to you members, help your officers to get to know you better.

Now Mr. Varker and Mr. Peyser, if you will rise, I will extend to you a handshake and thus induct you into office as directors of this association for a term of two long, hard years; and then another fate will be in store for you. (Martin Meyer was not in attendance.)

I don't think we have ever had a more dignified or impressive group of vice-presidents. I wish you gentlemen would stand, please, so that each member present may really get a good look at you. Gentlemen, I can say about the same words to you. Unless you participate in all the activities of the group, you are not going to get much out of it, and neither will the organization get much out of you. I know you will not fail to live up to your obligations.

Mr. Shaver, you are a new man in the work of this association, but you have considerable knowledge of what is ahead of you. I don't know whether you are pleased, apprehensive, or just how you feel about it, but I can assure you that the members of this association will be loyal, they will be ready to co-operate, and they will be ready to help you in any way that you may need help.

Mr. Church, this is now my gavel. I am going to turn it over to somebody else. But before I do, I want to express to you my personal appreciation for the work that you have done for this association during the last year and in all of the years that you have been connected with its affairs. Mr. Whiteman, I wish to express to you my personal appreciation of the work that you have done for this association. I should like to shake both of you by the hand.

Mr. Church: It is a great pleasure to receive this expression of appreciation, and I assure you that I appreciate the consideration that has been extended to me.

Mr. Bechtelheimer: Now, Mr. Chinn, what would you suggest I do with this gavel?

Mr. Chinn: I think we have a very excellent man to whom it should be given. He has been in training to use it properly for a good many years. We have watched him work; we have confidence in him; we know what he is going to do; and I think he is worthy of it. I suggest that you turn it over to Mr. Dove.

Mr. Bechtelheimer: Mr. Dove, on Mr. Chinn's recommendation, and in view of the fact that you have been elected by this group to serve as its president for the coming year, I now present to you this gavel and all of the work that goes with it. The meeting is now up to you. (Applause)

New Officers Comment

President-Elect Dove: To begin with, I want to say that, with all due respect to George Rear's ability as an installing officer, I think Past-President Bechtelheimer has done a very fine job in installing our new officers, and I am sure that his words will stick with them.

I am deeply appreciative of the honor that you have conferred upon me. You have elevated me to the highest office within your power to bestow, and I only hope that I can live up to your expectations.

I know you will forgive me for saying something personal. Years ago, when I was out in the field engineer's office, my duties pertained to track, bridges, buildings, water service and a little engineering. Later, I was transferred to the general offices of our company here in Chicago and my duties pertained mostly to track. I soon realized that I was losing some of the bridge and building knowledge that I had gained, and that if I wanted to retain this knowledge and learn still more, it would be necessary that I keep in touch with bridge and building men. About that time, I learned of the American Railway Bridge and Building Association, and met F. E. Weise, past-president and a very good friend of this organization. So I joined.

There are two things I want to point out from this personal experience. One is that this association affords a means of practical education in bridge and building work. It prescribes its own courses of study; it furnishes its own instructors and also its own students. The other thing is—why did so many years pass before I learned of the American Railway Bridge and Building Association? I believe there are many men on the railways still in the same position that I was — men who have no knowledge of this association and its benefits. That is the fault of the association, and, as members of this association, I appeal to you, and to those members who are not present, to let others eligible for membership know of this association and its work. You have an opportunity to gain new members. You have an opportunity now, since you have adopted these amendments to our Constitution and By-Laws, to obtain Junior members. I hope you will exercise your privilege and bring in many new members. Every president, I am sure, wants to add new members to the association, not as a yardstick of his ability in conducting the affairs of the association, but because it shows a healthy condition in the organization in which he is so deeply interested.

As I heard the names of the members of the Executive committee whom you have selected to work with me this year, I realized that my task would be made easier, because these men have been chosen for their ability and the interest that they have displayed in the association in the past.

I should like to say to Past-President Church that I have enjoyed working with him. He has made the year very pleasant for us all.

We always lean on our past-presidents; those faithful men who come back each year to help make our conventions a success and to keep the association going. I would like to pay a personal tribute at this time to a few of these men—Past-President E. T. Howson, Past-President C. R. Knowles, Past-President Armstrong Chinn, Past-President T. H. Strate, Past-President A. E. Bechtelheimer, Past-President C. M. Burpee, and to another old-time member, George E. Boyd. They have all been very helpful during this convention.

Gentlemen, that is all I have to say. I am willing to work, and I trust that at the end of this year my efforts will have been as satisfactory as those of the men who have preceded me. I thank you.

At this time, it is appropriate to ask the officers to express their personal feelings about their new responsibilities. I will call first upon our first vice-president, F. H. Soothill.

Mr. Soothill: I appreciate the honor bestowed upon me by the association and I hope to merit the confidence placed in me.

President Dove: Our second vice-president, G. S. Crites.

Mr. Crites: I know of no reason why I should have this honor thrust upon me, but I appreciate it to the fullest.

President Dove: A. M. Knowles, our third vice-president.

A. M. Knowles: I am very appreciative of this high honor. I don't quite understand why I should be elevated so rapidly when I have been a member of the association for only such a short time. I feel that I lost a great deal by not having been associated with this body of men before; and I have done my best to bring this experience to the attention of others who were not members. I will redouble my efforts along this line in the future.

President Dove: Neal Howard, will you say a few words?

Mr. Howard: It has always been a pleasure to work with the association. I have had but a small part in the work in the past, but I appreciate the honor you have given me in order that I might, perhaps, serve more thoroughly in the future.

President Dove: Mr. Varker, will you say something?

Mr. Varker: All I want to say is that I consider my election an honor and a privilege and I am most appreciative.

President Dove: Mr. Peyser.

Mr. Peyser: I also appreciate the honor conferred on me today. I am a relatively new member and feel that there are others who might have served better. However, if my effort in behalf of the association will warrant what you have done, then I can assure you that I will make that effort.

C. M. Burpee (Ry. Eng. & Mtce. Cyclo.): Mr. President, also included in your cabinet are two of the older directors whose terms did not expire this year, both of whom I believe are in the room, R. E. Caudle and W. A. Sweet. I think it appropriate that they stand so the rest of the gathering may see the men who complete the Board of Directors.

President Dove: Will Mr. Caudle and Mr. Sweet please rise and be recognized? Do you two directors have anything to say at this time?

R. E. Caudle (M. P.): When I was elevated from a member to a director, I felt there had been considerable confidence placed in my ability, and so I have devoted every minute of time that I could, or all that was necessary, to undertake to keep up my end of the job. I want to assure you, Mr. Dove, that I will do everything in my power next year to make the convention in 1942 one of the best that the association has ever had. Please feel free to call on me for any assistance that I can render you.

President Dove: Thank you, Mr. Caudle. I am certain that I will need to lean on you for help.

Mr. Sweet, may we hear from you?

W. A. Sweet (A. T. & S. F.): While this last year has been a busy one, with many tasks to take care of, my activities in behalf of this association, as a director, have been most pleasant. I sometimes feel that if other duties had not been so pressing, I might have been of more assistance. I can assure you, however, President Dove, that throughout the remainder of my term, I shall devote my time to the association as best I can. You may depend on me for any support and help that I may be able to give you.

President Dove: Thank you, Mr. Sweet.

I must assure you gentlemen that I will lean heavily on you during the coming year. Conducting the affairs of this association is not a one-man job. It is the job of the Executive committee. It will be necessary that I have the full support of you officers.

I would like to at this time call on A. G. Shaver, our new secretary, for some remarks.

Secretary Shaver: Gentlemen, you have honored me in electing me to the office of secretary of your association. I pray I may be worthy of that honor. I have been much interested in looking over your reports and listening to the addresses. I want to congratulate you on the excellent work that you are doing. I can see why railway officers should be much pleased with the accomplishments of this association. In that connection, I noticed a splendid letter from Mr. Howson in the current number of Railway Engineering and Maintenance relating an experience and suggesting progress. I feel that, relatively, this association is only started in its splendid work. You will be astonished with the progress which will be made in the coming years.

As secretary, I hope all of you will feel free to contact me and make suggestions and criticisms. By working together, I believe we can do much for this association.

One more suggestion. It may be some of you have membership application blanks in your pockets. Just furthering what your president has said in that connection, you may have friends whom you would like to see in this association, and the more the merrier. I hope you will say "Hello" whenever you see me, because I am not an expert in always recognizing friends when I meet them.

President Dove: Thank you, Mr. Shaver.

Mr. Shaver has made some important remarks, gentlemen. This is your organization. We are your servants. The members of your Executive committee are merely carrying out your directions to the best of their ability and in accordance with what they believe to be your wishes. The association benefits and you benefit. You benefit by what you put into the association. We welcome suggestions from any of you. We want to know what you think, how you feel, how you believe we can build a stronger and better organization. That is all, gentlemen.

I want to announce that there will be a meeting of the Executive committee in Room 1219 in about 20 minutes.

Has anyone anything further to offer for the good of the association? If not, exercising the power vested in me as your president, I now declare the Forty-Eighth Annual Convention of the American Railway Bridge and Building Association adjourned.

The convention adjourned sine die at 4:35 p.m.

COMMITTEE REPORTS, TECHNICAL PAPERS AND DISCUSSIONS

Protection of Bridges and Roadway From River Bank Erosion

Report of Committee

A. B. Chapman, *Chairman*, Office Eng., C.M. St.P. & P., Chicago; R. E. Caudle, *Vice-Chairman*, Asst Engr., M.P., Houston, Tex.; E. M. McCabe, *Vice-Chairman*, Supv. B. & B., B. &. A., Pittsfield, Mass.; G. A. Allen, Brdg. Insp., C. &. O., Clifton Forge, Va.; W. L. Baker, Brdg. Insp., C. & E. I., Salem, Ill.; M. Bear, Estimator, C. & N. W., Chicago; J. E. Bird, B. & B. Insp., N.Y.C., Corning, N. Y.; N. Buckley, Brdg. Insp., M.P., Palestine, Tex.; B. J. Chamberlain, Supervisor of Scales, C. &. E. I., Danville, Ill.; A. R. Harris, Asst. Bridge Engr., C. &. N. W., Chicago; J. E. Hogan, Asst. Div. Engr., C. & O., Hinton, W. Va., N. D. Howard, Managing Editor, Railway Engineering and Maintenance, Chicago; W. G. Kemmerer, Asst. Engr., Penna., Chicago; A. A. Sirel, Engr. Draftsman, C. & N. W., Chicago; J. S. Vreeland, Associate Editor, Railway Engineering and Maintenance, Chicago; C. H. Wells, Div. Engr., C. &. N. W., Boone, Ia.; and W. E. White, General Foreman B. & B., A.T. & S.F., Chanute, Kansas.

A. B. Chapman
Chairman

An assembly such as this knows that the watchword of the railroads today is "service with speed and safety," and that under this watchword, the speed of trains has jumped by leaps and bounds during the last few years; that passenger trains are maintaining average speeds across the continent of a mile a minute, with running speeds up to 110 m.p.h.; and that heavy tonnage freight trains, with their increasingly heavier equipment, are moving at speeds almost double those of 20 years ago. It also knows that all of this is being done to improve service and to recapture the business that the railroads have been losing to the airplane, the automobile, the truck, the waterway, and the pipeline carrier.

The protection of railroad bridges and roadway from river bank erosion is vital to the maintenance and furthering of such service with safety. Francis Bacon said that "Nature, to be commanded, must be obeyed." So it is with water making up the tiny rivulet or the mighty river. That portion of the water that falls upon the earth's surface and continues its way toward the ocean is what concerns us in this study. We know that it abides by certain quite well-established rules in playing its "war" game, and if we are to control it, we too must know these rules and the characteristics of the earth's surface over which it passes, so that we can shape it to our needs.

Water flows under the force of gravity at a velocity dependent upon the gradient and the channel friction, and it flows in a straight line unless acted upon by outside forces. Whirlpools abound in deep water at the bends in rivers, and at places of change in direction of the current due to obstructions in the channel, greatly increasing the normal stream erosion.

The flow of water in rivers and streams sets up a continuous change in the channel by erosion and silting. Erosion takes place by solution, suspension and corrasion—that is, by the mechanical action of the movement of the suspended particles along the stream bed. The greater the velocity of the water, the greater is the load it will carry and the greater the load that will be deposited when its velocity is retarded. Some torrential stream beds have been known to have deepened as much as 30 ft. during flood flow, and 10 ft. to 15 ft. is not uncommon. Then, when the flood stage has passed, the stream bed is restored to its original elevation.

Rivers in flood stages carry staggeringly heavy loads. The San Juan river, by test, was found to carry 75 per cent by volume of silt and sand. When the bridge and trestle were constructed across the Skykomish river, a torrential mountain stream, near Sutan, in Western Washington, the stream was spanned by an 150-ft. through Howe truss. Today, there are five such spans, with only three of them over flood waterways.

Preparation to Meet High Water and Erosion

The protection of bridges and roadway from river erosion presents a serious problem to most railroads. As soon as it is determined that a bridge may be endangered or the roadway washed away, the necessary protection should be installed promptly. Otherwise, interruptions to operation may occur, and heavier expense be incurred in both emergency work and in subsequent permanent protection. When the water is at low stage and the weather is clear, an erosion encroachment does not appear nearly so dangerous as when the water is at flood stage in wet weather. The absence of extreme flood flows for a series of years in which rainfall is light, or uniformly distributed, is no assurance that severe floods may not occur. For these reasons, the installation of bank protection should not be deferred where indications are that a bridge or roadway will be under-cut or endangered by a few more floods or continued high water.

Periodic Inspection

Most roads provide that at regular bridge inspections, stream conditions shall be observed so far as they affect the safety of bridge piers and abutments, the thoroughness depending upon the degree to which the line is exposed to damage. In addition, many roads require that the maintenance forces on the ground observe situations continuously where trouble may occur. In some locations, special inspections or surveys are made after each rise or runoff.

For all locations where erosion is in evidence, special maps should be made and kept up to date. These should indicate the extent and trend of the erosion, and will be most valuable in designing the proper protection. Such maps should show the existing structure; the depth of footings, and piles if any; the stream conditions adjacent to the bridge or roadway in question; the location of other structures or roadways; the watershed area; the soil conditions and condition of the terrain; the contour and direction of the stream; the low and flood water stages; and the dates and elevations of high water of notable floods that have occurred. In some cases it may be desirable to take soundings around each pier and abutment each year, and to keep a tabulated record, so that changes in the stream bed may be noted readily. Inspection by divers at important bridges subject to tidal action or other severe scouring forces may even be desirable.

For the information of field men during storms and high water, it is desirable to mark permanently on abutments, piers and bents the depth to the bottoms of footings and the average distance down to the points of the piles. This information is essential in connection with soundings made to determine whether a structure is safe for operation.

Instructions for Handling Floods

Roads exposed to storm or flood damage must, of course, have a complete understanding among their maintenance forces as to how to meet flood and high-water emergencies as they occur. This may be covered by general and special rules governing all employees concerned, or by special instructions issued for each occasion by the officers immediately responsible. Most important is the necessity of having the men and their supervisors experienced and trained to take the action necessary. Certain designated supervisory officers must be held responsible for taking charge and organizing the protection and repair work needed.

Illustrative of the detailed provisions of such rules covering times of severe storms and high water are—that trackmen are to patrol all track and bridges threatened, must carry signals for stopping trains, must advise train crews of portions not yet patrolled, and must report conditions to designated officers by wire; that section foremen are to proceed over adjoining sections until assured that those sections are covered; and that bridge crews are to be on duty and in communication with telegraph stations, ready to go at once to make repairs. In other cases, bridge men are required to patrol all bridges during high water; to inspect line and surface and look for scour; to clear channels; to leave a man at the bridge involved to watch its action under trains; and to follow the flood and keep debris moving.

A few roads carry large stocks of emergency materials, but the more general practice is to hold small stocks in readiness at strategic locations, unless regular stores department stocks or commercial supplies are available quickly enough to meet all ordinary emergencies. The correct number and location of emergency store points are developed by past experience and depend upon the location of regular stores department store houses and the accessibility of commercial supplies. Facilities for quick loading and forwarding are essential.

Among the materials kept in stock for emergency repairs are timber trestle material (enough for 50 to 300 ft. of bridge), ties and timber for cribbing and blocking, track material, stone, gravel, slag, broken concrete, riprap, cinders and other material for filling. In some cases, the material is held loaded on cars. Sandbags, woven wire, tools, dynamite and other supplies are included.

Expedients for Protection Under Flood Conditions

Unexpected high water stages, clogged culverts and bridges, or changed waterway channels may make necessary temporary measures to protect or restore bridges and roadway, although such measures are always more costly, and the efforts put forth are much less effective than would have been had proper protective work been done under normal conditions. Derrick or two-man size riprap is used extensively around piers and at abutments for emergency protection. However, the placing of any such material may decrease the channel cross-section, increase the velocity of flow, and set up eddy currents which may increase the extent of the erosion under and around the loosely-dumped rock.

Bundles of willow or other brush, weighted down with rock or sandbags and thrown into whirlpools in deep water near structures or embankments, are quite effective in breaking up eddy currents that cause scour. If the flow is too rapid, they should be fastened to the bank with wire to hold them in place. Bags filled with sand or earth for temporary emergencies are most effective when used as a paving or revetment on the slopes and tops of embankments. This type of protection prevents the erosion of the embankment material due to currents alongside or over-topping the embankment. It is not very effective in the bed of a stream or where bank cutting has already started, as the heavier material carried by the flowing water will cut the bags and wash away the sand or earth.

Logs or trees, with branches intact, lashed to the banks are effective as temporary expedients in shallow streams. In deep streams their buoyancy makes them ineffective against currents below the surface. Brush revetments weighted down with rock are effective protection, but they are difficult to place and to anchor properly during high water. Timber revetments are difficult to sink in water of any depth. Because of their rigidity, the current is likely to get between them and the bank and thus permit its cutting action to continue. Automobile frames and bodies are sometimes used for emergency measures, and have proved satisfactory, but the cost is quite high.

Where flood levels reach the superstructures of bridges, it may be desirable to weigh them down with cars of coal, gravel or any other available material to prevent their being carried off their supports. Unless this expedient seems reasonably likely to be successful, however, it should not be used, because the failure of the loaded bridge may cause greater damage than if the unloaded spans are carried off by the stream. Other expedients used under these circumstances are to hold the spans by means of cables attached to deadmen or to piers, and the driving of wedges between the backwalls and ends of short spans.

Removal of Obstructions

Bridge superstructures are usually anchored to their supports to afford some resistance to lateral displacement, but these anchorages are not designed to withstand the ultimate pressure of the stream against the structure. Anchorage that is too effective may cause greater damage to the spans than that caused by moving them off their supports.

The removal of obstructions in streams will generally be more effective in the smaller streams with high velocity and quick run-off due to narrow valleys, steep slopes, thaws and ice break-up. It is of questionable value in large meandering streams of low gradient and slow current, and those of constantly shifting channels in alluvial soils. Accumulations of logs, brush and other drift material lodged against a structure and obstructing the waterway should be removed before the next period of high water.

The methods of removing such debris include hand labor with pike poles, axes, saws, etc., used by the local section forces, and, where necessary, the use of explosives, locomotive cranes, draglines and other power machinery, working from the track or bridge, which is generally done by the bridge maintenance forces.

Protection of Substructures

Railroads are exposed to attack by stream erosion in two ways: (1) at bridges where footings or pile supports may be endangered by the scouring out of the foundation material by the current, and (2), by the encroachment of the stream upon the roadway and behind the abutments of bridges. The kinds of protection that will be effective in each case depend upon the velocity of the current and the nature of the soil through which the stream flows.

Mountain and upland streams are characterized by steep grades over rock or other hard bottoms, and carry loads of gravel and boulders, and sometimes drift and ice to a greater or less degree. The beds of such streams are thus subjected to severe erosion, from which bridge substructures must be protected. Where bridge piers and abutments are of concrete masonry founded on durable bed rock, the structure is presumably designed for stability against any possible flood flow through the bridge, and no other protection should be needed.

Where foundations are of gravel or sand, scour around and beneath footings is generally prevented by riprap. Where swift currents are involved, derrick riprap is carefully placed to a smooth surface, with no projecting faces that will cause the rock to be dislodged by the current. Two-man riprap for shallow streams and one-man riprap for very small streams are generally satisfactory, provided the current is not fast enough to move the stones; which may be judged by the size of the boulders actually carried along by the current. Riprap with the voids filled with concrete is effective in preventing its being moved around or washed away, unless it is undercut.

Fascines have been used to hold sandy bottoms under and around piers subject to heavy scour, and to stabilize and hold piers in position where they rest on piles in soft silt bottoms. This construction consists of oblong circular wire cages filled with rock and stiffened with poles. These are laid criss-cross on the river bottom around the piers, and when sand is scoured out by high water, the mats of interlaced fascines sink to the newly exposed bottom. As the flood recedes, silting of the bottom covers the mats, which remain in place to prevent dangerous scour during subsequent floods. An interesting application of this method of protection has been used by the Chicago & North Western at its Niobrara River crossing, at the point where this river joins the Missouri river, near Niobrara, Neb. The river in flood scoured out about 20 ft. of sand and silt below the pier footing, down to a clay stratum, leaving the foundation piles without lateral support. Following the installation of fascines at this point in 1929 and 1935, no trouble has been reported.

Check Dams

Pile piers in swift streams may be protected effectively by rock-filled timber cribs, or by plank sheathing bolted to the piles, with a small space between planks. Where trouble is caused by large amounts of sand, gravel or boulders, carried by streams with steep gradients, being deposited in openings and over the track, and at other times scouring and undermining foundations, the installation of check dams in the stream bed to reduce its slope to a non-eroding grade, has proved very effective. These dams may be rock-filled timber cribs, concrete or stone laid up in mortar, creosoted timber, or steel sheet piles. The downstream face of the check dams may be vertical, but, if so, ample stone or concrete protection should be placed to guard against undermining. The pictures in Fig. 1 show the result of installing a series of check dams in a stream by the Milwaukee. Similar results have been effected at a number of points on the Erie, where the movement of gravel and heavy debris in high-velocity, torrential streams has been controlled.

Large check dams, in general, should be considered as spillways, and shaped to conform to a hydraulic curve to control the velocity of the water at the outfall. If the line of the outfall curve extends somewhat below the level of the lower channel bed to form a pool, the jet action of the water will be broken and it will flow on at a velocity dependent upon the gradient and the roughness of the bed. The depth of the pool should be varied to the volume of water expected.

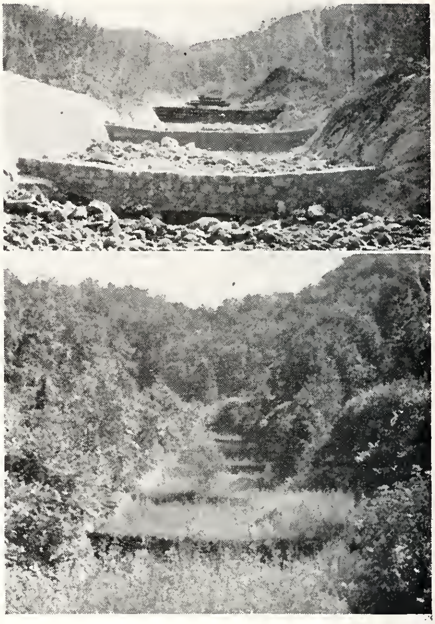

Fig. 1—Control of Erosion by Check Dams on the C. M. St. P. & P., Near Lake City, Minn.; Top—Dams in Place April, 1939; Bottom—Same Dams August, 1941

In some situations, where bridge piers are exposed to considerable drift and ice which might collect on the piers and cause scour, such drift and ice can be intercepted by protections placed upstream from each pier. Where piles can be driven, single piles, pile dolphins, pile cribs filled with rock, steel sheet pile dolfins (rock or concrete filled), or various types of ice breakers can be used. On rocky bottoms, timber cribs filled with rock and anchored to the bank may be necessary.

Streams in wide valleys, having low velocities due to flat grades, will usually present no erosion difficulties if the bottoms are of coarse, well-consolidated materials like gravels. In most regions, however, such streams flow through light, easily-eroded soils, and adequate protection of banks and bridge foundations may become a very serious matter.

Bridge foundations must be designed for combinations of circumstances that may produce deep scour at almost any point of the bridge crossing. Concrete and stone piers and abutments are most commonly used; pile piers are common where low cost is desired. Foundations must necessarily be carried to a considerable depth below stream bed; in large and important structures, by sinking caissons or cylinders to rock or other firm strata, often at great expense. For smaller structures, pile foundations must be carried down to secure adequate bearing power as well as to be below possible scour.

Underpinning Foundations

Where stream bed erosion has removed part of the foundation material beneath footings or from around piles, and where the structure has not moved out of position, underpinning, to restore full bearing and insure adequate support on the foundation, must be carried out with care and thoroughness. Underpinning should preferably be carried to rock or other firm strata, and the toe width should be increased to take care of the overturning moments. Where material has been washed out from around piles, the structure cannot be considered safe unless several feet of pile penetration in good material remains.

Steel pile piers and steel pile foundations are recent developments which offer effective protection against deep scour. Steel piles of "H" section, can be obtained in longer lengths than wood or concrete piles, and can be driven in continuous lengths to still greater depths by splicing on additional sections. Steel sheet piling is frequently driven around piers and abutments to prevent stream bed erosion from undercutting the footings. To insure full protection, sheet piling must be driven well below the ultimate possible scour.

In cloudburst territory, even where stream beds may be normally dry, flood waters, easily eroding the banks and carrying silt and light drift, sometimes leave the stream bed at a higher elevation after floods have passed. In these cases, more than usual foresight is needed to visualize the damage that can be done by the extraordinary conditions that may occur, and to provide adequate protection against it.

Rip rapping around piers and in front of abutments will leave a considerable part of the stream bed exposed to scour, which may undercut the rip rap. In such cases, adequate protection may require paving the entire width of stream bed under the bridge, and the use of cut-off walls at the upper and lower ends of the paving, carried deep enough to prevent the scour from undercutting. The paving may be of concrete or rip rap laid with a smooth surface, the size of the rip rap depending upon the velocity and carrying power of the stream at flood stage. Concreted rip rap is also used extensively for paving.

Steel and creosoted timber sheet

piling provides a most effective construction for cut-off walls. The driven wall has the advantage that the adjacent stream bed, where cutting action is most likely to start, is left undisturbed.

Cloudburst damage to the roadway at points other than at stream crossings may result from inadequate ditches and dikes adjacent to it. The obvious remedy is to maintain right-of-way ditches of adequate capacity to carry any flow that can be anticipated, and, in locations where velocities will be such as to cut into the embankment, to protect it by suitable means.

Bank Erosion

Where a stream tends to cut its banks at locations which threaten the track or bridge structures, some form of bank protection becomes necessary. Bank erosion should never be permitted to become so aggravated that emergency measures have to be taken. Protective measures may consist of line changes, channel changes or bank protection and stream guidance. The Santa Fe made extensive line changes and channel changes to overcome flood damage in Cajon pass in California in 1940, and, in connection therewith, placed extensive systems of bank protection, consisting of blanket bank paving of concrete and rip rap, stream deflectors, rip rap rail-crib dikes and steel jetties.

Grouted slag blanket bank protection has been used extensively by the Western Maryland, at a cost of approximately $13.50 per lin. ft. for an average slope width of 27 ft. It was found that the grout extended and proved effective to a depth of 5 ft. below the water surface.

In regions where streams are located in very stable formations and have well-established channels, changes in the channel are undertaken rarely, and only where careful study of each situation indicates that such a change is justified economically. The more common practice is to maintain and protect existing channels. Damage claims may result from ill-considered channel changes, and the costs of acquiring property or the consent of property owners must be considered.

Channel Changes

It is often difficult to force a stream to follow a newly dug channel. At the first rise the channel may become filled and the expenditure wasted. A diversion dike should be built to direct the current into the new channel, confining a sufficient portion of the total flood flow to scour the new channel to capacity.

Hard points and projections in banks that tend to deflect the current in the proper direction away from bridge piers or the roadway should be protected promptly. By so doing the ultimate cost of protecting the structure itself may be reduced considerably.

Where channel changes shorten the path of the stream, the slope is increased correspondingly, causing a higher velocity of flow. This will result in a period during which erosion and silting take place, before a new condition of equilibrium is reached. In this interval, attention must be given to protection and training works that may become necessary.

Bank protection may consist either of structures which deflect the current away from the banks, or of protective materials applied to the banks to prevent the flow of water alongside from cutting into the softer material. Structures designed to slow down the current alongside the bank vary with the kind of stream bed and kind and amount of debris carried by the stream.

Cribs and Dikes

Rock-filled cribs afford good protection in streams that have rock or other very hard beds. The timbers should be laid in both directions between successive layers of large stone. The cribs should have a wide base, with sides that slope easily to the top. They should be located at an angle of not more than 45 deg. with the bank, and be directed downstream. Cribs at right angles set up whirls against the bank on the downstream side and back-cut the cribs. Cribs should be placed well into the bank. In many cases, rip rap should be placed the full distance between all cribs and for some distance up and down stream from the end cribs. Willows or brush that will grow in the soil beneath the rip rap should be encouraged. If slides occur, the exposed surfaces should be protected promptly. Care should be taken to get the toe rock well placed out on the river bed to keep it from being undercut. This type of protection is equally effective at bridge abutments where the bank tends to cut.

Rock-filled crib dikes have been built with scrap steel rails instead of timber. Such a crib, used by the Santa Fe near Monrovia, Cal., was built of two lines of rails six feet apart, driven deeply into the ground, the rails being spaced three feet apart in each row and tied together by four horizontal lines of rails at four-foot intervals, with short rails tying the two rows together. The entire assembly was fillet-welded at all intersections, and was filled with derrick-size rip rap.

In wide, shallow streams through soils that are not too easily eroded, effective protection from erosion during high water can be obtained at comparatively small cost by means of shear fences, which act to reduce the velocity of the current along the bank. This construction consists of well-braced piles, faced with timber, built on a straight line and at an angle of not more than 20 deg. with the bank line. The fence should be placed well into the bank at its upper end, and the bank properly sloped and rip rapped for some distance upstream from the end of the fence. Shear fences should be built of creosoted material; otherwise they are short lived and may be weak or rotten when needed. Rock fill is sometimes placed behind the fences, particularly in deep water.

Another inexpensive and effective type of protection, which acts as a current retard, is that commonly known as steel jetties. It is used extensively in the midwest and southwest. It consists of steel angles placed in inclined directions, braced against each other and laced with wire or cable, and anchored to deadmen in the stream bank. The obstruction afforded by its members as they catch debris in the overflow channel, reduces the velocity of the current and eddy currents sufficiently to cause them to deposit their load of silt, thus building up the stream bed and protecting the adjacent bank.

Automobile frames have been used in the middle west as stream retards to protect erodible banks. Three frames are usually wired together into a unit; several of these units are assembled end to end and are anchored by cables. They have been found effective, but are quite expensive to install properly. In some locations they may be objectionable because they are unsightly; in others because they are moved too easily by ice.

Rivers through soft alluvial soils, which erode rapidly from either direct contact with the current or saturation of the bank, are most difficult to control. Works required to control their changing currents are quite difficult to design and install, and their cost may range from $30 to $200 per lineal foot of bank protected.

Revetments

Where the river channel is restricted in width sufficiently to increase the velocity of flood waters, scouring, sometimes to great depths, and rapid erosion of the banks, must be prevented by some form of mattress or revetment work. This will include waterways 30 to 60 ft. in height above the stream bed, with low water stages 5 to 10 ft. above the bed and flood stages at or several feet above the top of the bank. Current velocities at high stage may be as much as 6 to 9 m.p.h.

For such locations, a flexible concrete revetment is considered the most permanent and, incidentally, it is the most expensive type, if installed properly. The bank is sloped 1½ to 1 or 2 to 1. The revetment is cast on the bank and passed over a barge into the water. Forms are built with partitions about 12 in. by 18 in., 4 in. to 6 in. deep, with heavy wire mesh or small cables placed in the center of the forms. The concrete is poured in the forms and, when cured, the forms are lifted out and the jointed slabs are moved over the bank to make room for successive spreads. This is continued until the lower edge of the revetment is well out in the bed of the river. Great care must be taken to protect both the upstream and downstream ends of the revetment from being back- or under-cut.

This type of protection costs from $75 per bank foot on 40-ft. banks, to $150 per bank foot on 60-ft. banks.

Fascine mattress and mud cells, made of either willow brush or low-grade lumber weighted down with rock, have been used extensively with considerable success. They are installed in a manner similar to the concrete revetment described above. Their life is short due to decay of the brush and lumber, and they are quite expensive per foot of bank protected.

Loose rock revetments placed on soft banks in deep rivers are entirely too expensive in first cost, as well as in repairs and replacements, due to undercutting with resulting slides. Slides expose the bank to the action of the current and concentrate the rock out in the bed of the river, permitting the current to get between the rock mounds and the bank and cause erosion. This difficulty applies to all heavier materials, such as scrap automobile bodies, freight car bodies, and locomotive tenders and fire boxes, that may be available for "tumbling" into streams to stop erosion. When the current gets between these bodies and the bank, erosion will continue.

Rip-rap revetments have been used effectively for bank and embankment protection where more than usual attention has been given to the size and durability of the rock, and to methods of anchoring them in position. The rock should be placed with care to form a continuous interlocked blanket three to five feet thick, extending well above high water, with the top edge formed of derrick-sized pieces. The blanket should be keyed into the stream bed to a depth of five feet or more. So important is the anchoring of the blanket that where severe scour is anticipated, the toe should be protected by rail fences or dikes, or by two or more lines of steel jetties. Rail fences or dikes consist of scrap rails driven vertically against the buried toe of the rip-rap blanket, with one or more horizontal lines of rails connected to the vertical rails and anchored into the embankment by cables.

Another typical kind of concrete revetment used recently by the Santa Fe in Arizona consists of a reinforced concrete pavement, cast in place against a carefully-compacted fill. This is carried up to a height of five feet above maximum high water, and is extended deep enough into the waterway channel to prevent its being undermined, in some cases as much as 30 ft. below stream bed. Where severe wave action is expected or where high water is close to the track subgrade, a splash wall curb is placed at the top of the wall to turn waves back into the stream. The slabs are 6 in. thick, reinforced with ½-in. round bars spaced 12 in. on centers both lengthwise and up the slope, and are provided with expansion joints about 60 ft. apart, keyed with dowels.

Velocity Retards

In streams with soft banks, severe cutting may occur at bends. Protection at such points usually consists of some form of current retards to cause the deposit of silt in the bend and to direct the current along the inner ends of the retards. Timber groins projecting out into the stream, constructed of piling, with wale boards on the upstream side, are frequently employed. If built of untreated timber, a life of 6 to 10 years may be obtained; if constructed of creosoted timber, a life of 20 to 35 years may be expected. To prevent their being back-cut, it is necessary to protect the bank between the groins and for some distance upstream and downstream.

Current deflectors, either of the steel-jetty type already described, or timber deflectors, or a combination of the two, have proved to be the most economical and efficient protection to stop bank erosion along deep rivers in easily erodible soils. Timber current deflectors are built of a series of three-pile bents, spaced 8 ft. to 12 ft. on centers. The channel-side pile of each bent is battered, with an additional battered pile in line between each bent. The back pile of each bent is also battered. The bents are cross and collar-braced; bracing also extends from the intermediate pile to the back pile of each bent, so that the pressure on one bent or intermediate pile is transferred to the bents on each side. All bracing is bolted, rather than boat-spiked to the piles. Three-inch by eight-inch wale boards are boat-spiked to the channel-side batter piles from the top of the fender to low water level, a space of 2 in. being left between the boards. If the depth of water below the wale boards exceeds five feet, a line of small retards should be laid and anchored along the channel side of the fender to break up the current passing under the boards.

It is the "toe" current, or the movement of water under pressure along the bottom of the bank slope that does the greatest damage in the deeper rivers. The current above the upper half of the bank, being under less pressure, does very little cutting. It does, however, saturate the material for some distance back from the bank, as does also the water in the lower half of the stream. To stop erosion, it is necessary to dissipate the "toe" current and to retard the upper current. It is also necessary to keep the material that caves in from the bank from washing away, and to retard the current sufficiently to deposit silt for some distance out on the bed, to maintain a flat slope on the bank.

Placing Jetties

The lines of fenders or jetties should not be placed at an angle greater than 35 deg. to the bank line, downstream from their beginning points. Furthermore, they should be extended well into the bank. Since fenders are intended to dissipate the "toe" current and deflect it at an easy angle away from the bank, they need not be more than half the height of the bank.

To protect the portion of the bank above the fenders, a flexible type of velocity retards should be laid on the pre-sloped bank, extending well out into the water on the bed of the stream. These retards should be well anchored to dead-men located some distance back from the bank, the various units being cabled together. In addition, two lines of cable should be installed parallel to the bank, one line being run through the units in the water, and the other through the units half way up the bank. This latter anchorage is to keep the units from being rolled or displaced by the current. These retards will dissipate the current next to the bank, catch drift, trash and silt, and protect vegetation and brush, all of which will, in a few years, form a well-stabilized bank. The retard installation should begin well above the upstream fender and continue below the lower fender.

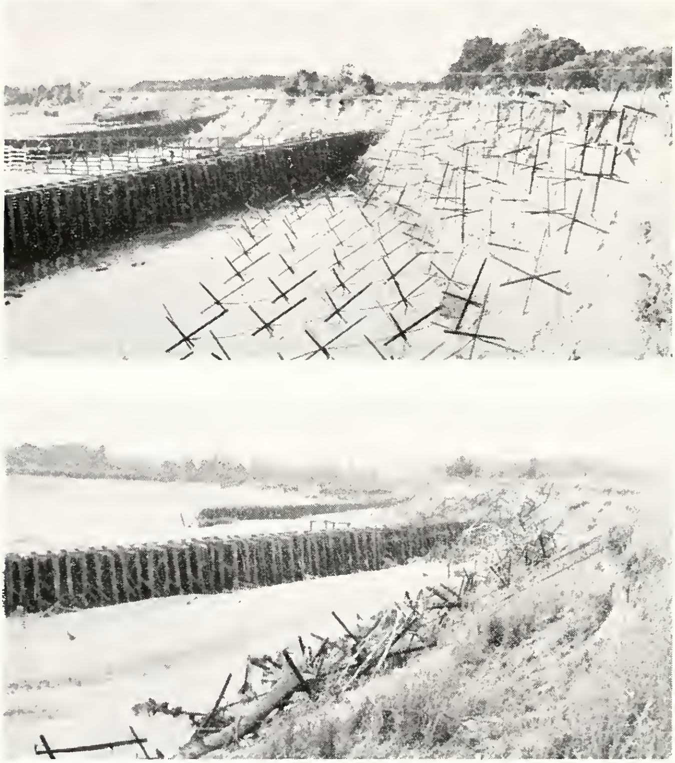

Fig. 2 — Control of High Bank Erosion by Timber Retards and Steel Jetties, Brazoo River, along the I. G. N., Near Bufkin, Tex.; Above—Soon After Installation in 1936; Below—Two Years Later; Note Deposit of Sand and Growth of Willows

Only creosoted timber should be used for constructing fenders and retards, as untreated timber will seldom last until its purpose, the moving of the channel away from the bank, is fulfilled. The fenders cost $18 to $24 and the retard work $10 to $15 per foot of bank protected, depending upon the height of the bank.

Examples

Many examples could be cited where the above described protection has been effective—some of the more notable of these are:

(1) Wharton bend, at Wharton, Tex., where construction of the protection was started in October, 1940, along a sandy bank 48 ft. high. Here, flood waters topped the bank three times during construction. In January, 1941, a fine growth of willows covered the bank, and the main channel had moved 300 ft. away, cutting away 100 ft. of a gravel bar on the opposite bank.

(2) The Bufkin channel protective works along the International-Great Northern on the Brazos river in north Texas. Note the pictures (Fig. 2) taken at the time of construction in 1936, and a scene from the same location two years later. The railroad is along the top of the bank at the right, in front of the trees. Four hundred feet farther to the right is another large river.

(3) A third good example is along the Santa Fe at its crossing of the Pease river where, in two years' time, a system of retard jetties, without any deflecting fenders, built up a silt deposit half the height of the retards, and the once barren sand river bed soon became covered with grass, reeds and small brush. The river bank is considered as low, being less than 15 ft. high.

Shallower streams in easily-erodible soils may be controlled easily and quite economically by the use of only the velocity retards, placed in what may be termed current-diversion lines, reaching from the upper to the lower ends of the portion of the bend where erosion is active. Additional units should be installed back of the diversion lines, extending to the top of the bank, where they should be securely anchored to dead-men. The cost of this type of work in rivers with depths less than 30 ft. is from $8 to $14 per foot of bank protected. In depths less than 30 ft., deflecting fenders are seldom necessary, except that one or more short ones may be required in sharp, large-angle bends.

The flood and erosion problems of the railroads are likely to increase with the years, particularly in the newer parts of the country, due to the clearing of land, the drainage of swamps and other ditching for improved drainage, the removing of obstructions from streams, and numerous other operations causing water to drain more rapidly from watersheds into main streams. This results in more frequent and higher water stages, with resultant increase in current velocity, all of which increases bank erosion, particularly in streams where the banks are of soft material.

If the railroads today would pay more attention to providing flatter slopes in their cuts and on their newly-placed embankments, and, in many cases, would seed and sod the slopes, as well as plant and encourage fast, easy-growing shrubs or bushes where small washes may occur, nature would take care of many of our problems of roadway embankment disintegration.

DISCUSSION

G. S. Crites (B. & O.): Chairman Chapman and his committee are to be congratulated upon the very comprehensive manner in which they have handled this subject. It would probably not be in order, in view of the thoroughness of the report, to go into much discussion, but I have one or two thoughts which possibly entered the minds of the members of the committee during the preparation of its report.

Under the discussion of periodic inspection, which covers the subject quite thoroughly, no mention is made of developments, and changes effected by civic authorities. We must be on the lookout for highway bridges, other openings or improvements, and changes in streams made in connection with public improvements.

My first experience with such conditions was 30 years ago, where a county put in a bridge which deflected the water toward a high embankment, causing a washout which disrupted traffic on a transcontinental railroad.

Under the conditions which we have been facing for a number of years, and which we probably will be facing throughout our defense effort, materials to repair washouts may be hard to get. Therefore, those in responsible charge will best look for natural materials along the right of way. We just must do that. We can't always have the necessary materials in stock to protect any emergency.

Changes of Channel

In 1936, on one railroad, about 43 miles of line was washed out. Where the road was hit the worst, changes had been made restricting an adjacent channel. At one point this had caused the end of a 140-ft. bridge to be washed out.

In connection with the placing of cribs and dikes, it is very important to study conditions for a considerable distance upstream, because often a small crib or dike, improperly placed, may change the current of a large river. The growing of willows to retard erosion, as mentioned in the report, has been used from time immemorial. On the upper reaches of the Nile, where the natives were agriculturists, they would simply pull off the branches of the willows and stick them around promiscuously to retard the flow of the sedimented water, thus building themselves a levee to protect their fields. Willows were also used extensively by the Yuma Indians on the Colorado river, and by the Navajo Indians in Sonora, Mexico, to protect alluvial plains from wash. The whole tribe would go out and stick willow branches in the mud, and thus effectively protected their land from erosion.

Armstrong Chinn (Alton): I agree with Mr. Crites that Mr. Chapman and his committee are to be congratulated on presenting a very comprehensive and instructive report. I think that about all I can do is to comment on some of the things brought out in the report. Near the beginning, the statement is made, "When the water is at low stage and the weather is clear, erosion encroachment does not appear nearly so dangerous as when the water is at flood stage in wet weather."

Sometimes it is pretty hard to

tell by just looking over the situation, what might happen. I think of a case on our railroad where we have a 6-ft. by 8-ft. concrete box culvert draining an area a little under 10 acres. Normally, that box is several times larger than is required, but one night a severe cloudburst occurred in that vicinity. This drainage area was in a cornfield, where the crop had been harvested, but the stalks were still standing. As the result of the storm, the wash was so severe that it carried the cornstalks down and plugged the culvert opening, causing the water to run over the track and to wash it out. An engine coming along a little later turned over, but, fortunately, no one was hurt.

Then, I think of a case on another railroad in Ohio, where I worked some years ago, which, to me, was almost humorous. The report states, "Foundations must necessarily be carried to a considerable depth below streambed." I think that is excellent advice. The case I am thinking of is that of a bridge over the Tuscarawas river. The original bridge was a deck truss that was getting a little weak for the power being operated over it, so the railroad decided to replace it with deck plate girders of shorter span. That necessitated erecting piers between the existing piers.

They thought they had carried those piers down to a suitable foundation of gravel. I forget just how many feet they went below the bed of the river, but they thought they were amply safe. These piers were erected and poured around the existing members of the deck truss. About the time they had the piers completed, there was a tremendous flood in the Tuscarawas river, which washed out the foundation of a couple of them. When the piers went down, naturally, being poured around the members of the deck truss, they pulled the trusses down with them. So the railroad had to build a pile trestle to handle trains while they were building a new bridge. This time, they went down deep enough.

When we think of corrasion and erosion, we ordinarily think of abutments or the track being washed out by having the material taken away from underneath it. We don't give as much consideration to the fact that we may have erosion in streams from bluffs adjacent to tracks, that will bring down a deposit of material and cover the track. Where this occurs, it is just as dangerous as if the track had been washed out from underneath. I have seen a lot of this, and I have seen some of the cures, as illustrated by the photograph included by the committee in its report.

Mention is also made of erosion trouble along rivers like the Mississippi, and particularly the Missouri. I don't know whether any of you have ever stood along the banks of the Missouri river down in the bottoms when it was really running, and suddenly felt the ground beneath you start settling. Near our track in the vicinity of Glasgow, Mo., I have seen chunks of bank about 50 to 100 ft. long and 10 ft. wide—10 ft. seems to be about the usual width in that territory—break away and start slipping down into the river. There is no cutting along the surface of the water. It is all by the "toe" current, as is mentioned in the report. In other words, this toe current undermines the bank at the bottom until a big slab breaks loose and starts slipping down.

Well, one time we battled at that particular location when the river was within 75 ft. of our track, and was cutting off these 10-ft. slabs. To stop the cutting, we laid a temporary track hastily along the edge of the bank and rolled old coal cars from it into the river. We tried to roll them in so they would land with their tops up, and thus gradually fill with sediment so the current wouldn't carry them away. When cars dumped in this manner finally settle down to the bottom where the toe current is located, they usually stop the cutting — temporarily, at least.

Another method we followed was as follows: When we saw a slab of bank starting down, we would build cribs of old ties out on it and fill these cribs with stone. The stone filling was to sink the cribs, because, as pointed out in the report, it is pretty difficult to sink a wood crib without weighing it down. By starting these cribs on top of a slab that was sinking into the river, and then building them up as the slab of dirt went down, we eventually got the cribs to the bottom of the bank where the toe current was doing the cutting.

I have heard is said by an old timer along the Missouri river that the river owns every acre of ground between the bluffs, and goes and takes whatever it wants whenever it wants to—and that is just about the way it looks to me.

At this particular location, where the river cut to within 75 ft. of our tracks, it is now about a mile away. The United States government built some very long jetties or levees in this territory to put a longer bend in the river and thereby slow up the current. The natural tendency of the river is to cut across between bends — to shorten its channel — and every time it shortens its channel, the speed of the current increases, which, in turn, increases the erosion. As the result of the government's work, which was done to make the river navigable, the stretch along our track, where the river was 55 ft. deep at the time of the flood referred to, has so filled in with sediment during subsequent floods that a farmer is now raising a crop of corn on it.

President Church: I was wondering if some one from the Erie would give us a little more detail about their check dams.

A. M. Knowles (Erie): We have a great many eroding small streams on our line, especially in New York state, that give us a lot of trouble. During heavy storms, they collect the water very rapidly and bring it down their respective ravines. Where these streams have gravel bottoms, the gravel and fairly large stones are brought down with the water. Where such conditions have been encountered, we have put in many small dams, mostly of wood construction, crib-like, and they seem to have done the trick—have stopped the rapid flow of water, and with it, the erosion. They are very effective in that respect. We have quite a number of additional dams under consideration now, and some of them run into sizable expenditures.

We don't have any very large eroding rivers like you have in the West, although we do have considerable revetment work going on in connection with government construction on some of our rivers.

L. D. Garis (C. & N. W.): I am a bridge inspector, and would like to relate certain of my experiences. We often find obstructions across culverts, such as wire fencing and farm gates, placed by farmers. Such practices may lead to a very dangerous condition and cause washouts.

Another matter that is quite apparent in that part of Iowa that I am now in, is the deposit of silt in streams. I believe the technical name for that is aggradation, as contrasted with erosion. There are many places where bridges, originally 17, 18 or 20 ft. above the streambed, can hardly be walked under now. This inadequate waterway creates a condition that, in flood stage, is very apt to cause erosion under the ends of bridges. I don't know of any method for remedying these cases of general aggradation, except the raising of the track grade. That has been done by the North Western at several locations, and probably will be done in more of them.

Another thing that I have noticed frequently is the use of small mounds of rip-rap or broken concrete near the ends of culverts and similar places. In many such cases this practice is of absolutely no value. If anything, it may help cause erosion when floods really come. I think it should be almost a general rule that anything except very heavy rip-rap should be either grouted in place or held in some kind of wire container.

President Church: I would like to ask the chairman a question. We have been carrying on extensive work on our line that we call a type of trenching and back-filling. In this practice, a dragline makes a trench, which is filled with rip-rap. Has that type of protection been described?

Chairman Chapman: No, it has not.

President Church: We have very extensive operations of this character along the Ohio river, probably running up to four or five years' work, and probably involving a cost of a million dollars.

I wonder if any other roads have undertaken similar trenching and rip-rapping operations. I consider it somewhat different than typical rip-rapping as described by the previous speaker, where the undertow current can cut in and cause the stone to settle down, permitting the embankment to be washed out. We have had instances of this kind where we didn't have the proper toe protection.

R. E. Caudle (M. P.): I have not gone into the rip-rap matter for a long while. Down in Louisiana and Texas, we have every river between the Mississippi and the Rio Grande to contend with. We cross some three or four times. We cross them in the hills and in the flat lands near the coastline. In the hills, we use bank protection entirely different from that used in the flat areas. Frequently, in the hills, where the water runs swiftly and is not so deep, we take care of erosion with heavy applications of rip-rap. We have to get the riprap well out on the flat bottom of the channel so that it will not be undercut. Where stone rip-rap is installed properly and toed into the bed of the river, so that the toe of the embankment will not become loose and slide, we have had very good results, particularly around abutments and piers.

In the flat country, we have tried

various types of bank protection. We had so much trouble in this type country that back in the early Twenties I made a study of bank protection used on various roads over the country to determine what type protection would be best for our particular needs. After a couple of years' study and some experiments, I settled on a type of protection similar to that shown in the accompanying photographs taken along the International Great Northern near Bufkin, Tex. In this particular location, in the photograph at the top, you will note the telegraph wires along the main line up in the right-hand corner. Just off from this picture to the right, there is another large river. There are only 600 ft. between the two rivers. They run parallel for about eight miles, and the I. G. N. operates on the ridge between them.

When this line was built in 1902, the larger river, near where the protection shown has been installed, was 3,000 ft. away from the track. In the period from 1902 to 1936, it had gotten over into the right of way and had taken off several hundred acres of land. The bank in this particular location is almost entirely of white sand. Our first thought was to move the track. To relocate the track well away from the river, however, would have required moving eight miles of it, at a cost of $460,000. So instead, we undertook the protection of the bank, and a total of $270,000 was spent on work similar to that shown in the photograph.

This picture shows the 13th dike. We did not hesitate to cross the channel of the river in building these dikes. They withstood the strain of the swift current. At the present time, the only portions of the 13 deflecting fenders, or dikes, that can be seen are the ends of the lower three. The entire area of the bend is now grown up with willows and silt has been deposited to the tops of the fenders. We are now permanently relieved and have saved a large amount of money over what the line change would have cost; perhaps a couple hundred thousand dollars.

There is not much use in moving a bridge, a structure or the track away from an eroding bank unless it may be moved back into the foothills. I had an experience of that kind years ago. Here, a bend in the river cut back into the main track. Consideration was given to protecting the bank at a cost of $50,000. However, the track was moved back 2,000 ft. from the bend, instead, for $40,000. In ten years' time, the river was over to the track again. The track was again moved. Perhaps it will have to be moved again or bank protection installed.

In protecting banks of light clay or stratified sand along deep rivers, it is very easy to install protection in the wrong place unless considerable study is made and records have been kept of the trend of the current. Adequate protection will be quite expensive. Perhaps the structure or track could be moved at a lower first cost than to protect the bank, but if this is done there is no assurance that the river will not be over against the structure or track again in a few years, with the same condition prevailing.

President Church: I would like to call attention to the picture in the report with the jetties that look like spider webs. I think that possibly more explanation in connection with this method of protection would be enlightening. Will Mr. Caudle explain just what that particular installation is? We are dealing here with sand, and these look like very thin members.

Mr. Caudle The plan worked out for this particular location was for the purpose of taking care of the toe current that Mr. Chinn referred to. What happened here was this —when the river would rise to a high stage, the sharp bend would cause whirls in the water which would cut out the vertical bank and saturate it for some distance back through the sand strata. Then, when the water would recede, the bank would cave quite rapidly. The current-deflecting dikes shown were installed by excavating well back into the bank for their inshore anchorages. These dikes were built only one-half the height of the bank, and, to keep the water from pouring over their top and cutting around the ends, steel jetties were used to back them up.

The jetties consist of three 4-in. by 4 in. by 16-ft. steel angles bolted together at mid-points. They have three or four holes in each angle, which are threaded with No. 6 wire. They make a rather compact mass of steel and wire and are anchored well back in the bank with one-inch cable. Each individual string of jetties has a double line of cable. Down in the water, next to the lower line of jetties, another double line of cable is installed to keep the jetties from being rolled out of place by the force of the current. All jetty units are thus fastened together both transversely to and longitudinally along the river bank. The jetties retard the current sufficiently not only to eliminate erosion, but to cause deposit of silt.

President Church: That type of protection is somewhat new to me and I thought it would be well to have it explained a little more fully.

W. A. Sweet (A. T. & S. F.): With reference to your question of a few moments ago as to the practice you are following of excavating a ditch with a dragline down to the bottom of the channel of the stream and then filling it with heavy stones, and continuing the rip-rap on up the bank; that is the practice we have followed in a number of instances in my territory, and with good success so far in each instance. We sometimes excavate a trench as wide as 16 ft. and as deep as we can go, and then fill it with the heaviest type of stone we can handle. Above this, to a point above the normal water line, we then face the bank slope with a lighter rip-rap.

In one stream, we have protection similar to that shown in one of the pictures, that is, steel jetties. In one instance, where the river bank was being cut away, we put in these jetties in just about the manner shown. They turned the current away from the bank and back into the center of the stream, and this not only protected the bank, but also resulted in eliminating a sandbar island that had been building up under our bridge. It really turned the trick and did a good job. In sandy streams, I would recommend this type of protection for locations of the kind I have referred to.

Mr. Caudle: With reference to steel jetties, I want to make this further explanation. They are not of sufficient strength to take care of extremely sharp bends. There are numerous places where the jetties alone will not take care of erosion. In such places, deflecting dikes must also be installed to furnish adequate protection.

F. W. Hutcheson (C.&O.) : There is one other type of rip-rap which has been used effectively on our James River line, and that is quarry-run rip-rap. Of course, this is applicable only to river banks that closely parallel the line of road, where dump cars can be used to place it. This stone is just quarry run, varying from very small pieces to boulders of considerable size. It is merely dumped from the cars and pushed over the bank with a spreader, without any particular attention being given to the placing of it. This, however, naturally places the larger boulders at the toe of the fill, where they are needed, and the smaller material higher up on the bank. This method is comparatively inexpensive, and has proved very effective in that particular location. It would not apply, of course, where high river banks and sandy materials are involved.

Mr. Crites: Does the Chesapeake & Ohio trench at the bottom of the fill to retain the larger stones, or is the material just allowed to rest on the surface along the base of the fill?

Mr. Hutcheson: Trenching is being done on the project to which Mr. Church referred, along the Ohio river, but in the project to which I have referred, along the James river, that was not done. It was simply placed at random over the surface.

President Church: Mr. Chapman, we certainly appreciate the large amount of work that you and your committee have done in preparing this fine report, and, on behalf of the association, I thank you for submitting it to the convention.

Possibilities of Off-Track Equipment in Bridge Construction and Maintenance

Report of Committee

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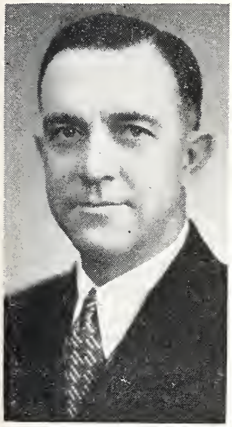

H. T. Livingston
Chairman

The subject of this report, with all that it implies, is of great interest to all railroad officers responsible for construction, operation and maintenance. Historical records and descriptions of methods and equipment are of little value except as a basis for study of ways to improve them. Current practices sometimes become obsolete almost before the completion of a project. Descriptions of methods contained in this report, are suggestive only, and serve principally to challenge us to study and to originate. The acceptance of known and successful procedures without investigation of other and possibly entirely different methods, indicates decadence or mental laziness.

The use of off-track equipment is not of recent origin. Machines used in the early days of railroad construction and maintenance were not operated and moved on tracks. They were generally hand or horse-powered. The mounting of equipment on wheels for operation on the track developed naturally, and its use continued until the internal combustion engine became commercially practical and economical.

A few of the basic factors which have made off-track equipment possible are internal-combustion-powered units with light weight per horse power; cheap, concentrated fuel; compact electric-generating units; portable, automatic-operating air compressors; high-capacity cranes that permit greater latitude in design; power-driven tools; electric and acetylene welding; the crawler tractor; the development of automobiles and trucks; and the accessibility to railway structures from all-season highways.

Character of Work

The maintenance of a railroad property includes the replacement of all of its physical units, from the smallest to largest. The viewpoint of each officer is influenced by the character of the work for which he is responsible. The need to save time and money and to facilitate train operation is a universal objective, and should not be overlooked, regardless of the magnitude of any project. Bridge repairs may be regarded as minor and major, the minor work including that wherein the handling and unloading of special tools and equipment or the use of work trains are not warranted.

To digress a moment—you often have a small job and you think, "My goodness! how fine it would be if I had certain tools on hand." At the same time, the chances are that if you had them, you wouldn't take the time to unload them because of the size of the job.

This discussion presupposes the work is sufficiently large to warrant the use of some type of work equipment.

Bridge maintenance on most railroads is divided into two general classes: (1) minor repairs to existing structures, chargeable wholly to operating expenses, and done by regular railroad bridge and building forces, and (2) major repairs, renewals and replacements, which appear on the annual bridge budget and are properly construction, rather than maintenance, items. Repairs in the first classification include the replacement of minor portions of frame and pile structures; deck renewals; the replacement of corroded or failed steel members; the adjustment of counters and expansion rollers; the replacement of shoes and bed plates; the renewal of masonry bridge seats and backwalls; the facing and encasing of piers; the protection of masonry footings from scour; repairs to masonry culverts and various types of waterproofing; the lining and grouting of arches; the installation of culvert pipe, etc. Major repairs include such work as the replacement of frame or pile trestles with treated timber or still more permanent structures of steel and concrete; the installation of permanent culverts; the strengthening of bridges to permit the operation of heavier locomotives; major changes in grade and alinement, involving bridges, etc. Work of this latter type may be contracted in whole or in part, or may be carried out by the organization of special company forces.

The committee made these divisions of work more than anything else to call attention to the various types of work with which the maintenance officers are faced, and was somewhat inclined at first to divide it between contract work and work done by the maintenance forces on the railroad payroll. It is largely a matter of choice.

Why Off-Track Equipment?

The use of equipment, whether "on" or "off" track, which will save labor in carrying out either of the above classes of work, should be given careful study. Why is off-track equipment needed? This is answered best by analyzing the objectionable and "fixed" features inherent in the use of on-track equipment. Such an analysis considers (1), economy, and (2) safety of use.

Most on-track equipment is steam driven, using coal or fuel oil. Such fuel is generally available at subdivision points, which requires that either the equipment be moved to the point of supply, or that the fuel be brought to the site of the work and the equipment be refueled by expensive hand methods. Water is usually secured by moving the equipment to the nearest water station. Expenses are reduced, but not entirely eliminated, by providing additional water cars. Local water supplies are often secured by means of syphons, pumps, etc., although the use of such local water, untreated, frequently is uneconomical because of its detrimental effect on the boilers and the subsequent extensive boiler repairs that usually are required.

I have in mind the use of syphons or pumps which you can drop in the stream at the bridge you are working on. I have known of several instances where the use of poor local water required the renewal of boilers on equipment because of the damage done — a costly job. Undoubtedly, you also know of such experiences.

The steam-driven on-track machine requires the employment of a night watchman, or the payment of overtime to firemen for building fires preparatory to work periods, and for the banking of the fires after the close of each day's work. Whether such work equipment is self-propelled or requires a locomotive, makes little difference, in principle, in this discussion. The self-propelled machine is generally more economical when the work site is close to a siding, but does not prove so economical when long distances must be traversed to and from work, and to clear for trains.

On-Track Machines Are "Fixed"

I think we all have had experience with contractors who have employed on-track equipment with the necessity for building spur tracks in the vicinity of the work. Usually, there is an argument as to who is to pay for the spur tracks.

The on-track machine is "fixed" as to work area at the job site. Its maximum radius limits the work which it—a pile driver, derrick, crane, etc.—is able to do. Such equipment, to be effective, frequently requires the construction of additional tracks, and may require temporary changes in local power lines to afford adequate horizontal or vertical clearances. The on-track machine is also "fixed" as to movement from one job to another. It must travel on the rails to any point desired, even though the distance across country to that point may be much shorter. Frequently, such a machine must, in moving from a job on one line to another job on a nearby parallel line, move 50 or more miles to a junction with the other line, and then return a similar distance to the new job, with a loss of one to as much as four days' time.

The on-track machine is also "fixed" as to the variety of work which it can do. Pile drivers are frequently used as derricks to load or unload material, but such use is uneconomical and should be limited to small quantities of material. The use of derricks is limited to areas near the track.

The economy to be derived through the use of any particular type of machine must be computed for each job, and a close estimate of costs, based on local conditions, can be made on the above mentioned points. Delays to the machine itself because of the necessity for clearing for trains can be estimated closely. The cost of delays to revenue and other trains, due to the actual stopping of trains at the work site or to slowing them down while the machine is clearing the main track, is indeterminate. It frequently happens that a machine will break down just prior to the time for clearing a main track, with consequent disruption of revenue traffic and resultant expenses at both prorata and overtime rates. Expenses for such failures cannot be foreseen, nor are they charged to the job, but they do increase the operating expense of a railroad. Any blockade of a main track, and especially of this unforeseen type, is unduly expensive, because train dispatchers depend upon expected performance of trains, and plan train movements accordingly.

Interferes With Routine Work

The use of any on-track equipment or work train is always detrimental to the efficient operation and maintenance of a railroad. It has been, however, largely a necessary evil. Such equipment or trains may have to pass through other maintenance or construction gangs, causing delay not only to themselves, but also to the gangs through which they must pass. Such movements are expensive, particularly to gangs laying rail, ballasting, or engaged in bridge erection. Local officers should plan their work to avoid such delays in so far as possible, but there are times when they cannot be prevented. An item of no small expense is the delay to other maintenance forces that must pass the work site during working hours. There may also be delays due to different hours of service for forces with different types of work equipment, causing overtime costs while waiting for the equipment to return to the nearest station at the close of the day's work.

In connection with most types of on-track equipment, there are certain fixed expenses which cannot be eliminated. Train and enginemen are generally required where the equipment is operated on main tracks and within yards. Contracts with the men in these crafts usually require continuous eight-hour daily pay, even though those in the maintenance-of-way crafts, in general, are paid for eight hours within nine, the lunch hour not being worked. If the lunch hour is actually worked, men in the maintenance crafts are usually paid full time for the lunch hour, with 20 min. off to eat. For the operating department men, therefore, there is at least one hour in a single-shift for which pay is given for time not worked, or for which pay is given at time and one-half. With on-track equipment, the time of both men in the maintenance crafts and train and enginemen, is usually based on starting and closing the day's work at the nearest station at which adequate lodgings may be had. Thus, unproductive time used in the trips to and from the work site must be paid for.

We are faced with unpredictable increases in expenses for the operation of on-track equipment due to unexpected interpretations of existing labor agreements, as well, as to the possible inclusion, in the future, of contract clauses which make necessary the employment of transportation employees who are not actually needed, and, in fact, who often slow up the work.

On-track equipment is generally built heavily and substantially. Repairs must be made at a shop, which generally produces long unproductive periods. It may become obsolete, but a railroad can seldom afford to scrap equipment for that reason alone. It has rapid depreciation for resale or trade-in, and the market for its resale is limited to short-line railroads. Furthermore, the cost of modernizing such equipment is generally prohibitive, as is also the cost of converting it for purposes other than those for which it was specifically designed originally.

There are some hazards in connection with the use of on-track equipment that do not exist with off-track equipment. Occupancy of a main track constitutes a hazard to train operation, and, therefore, full protection must be furnished. The certainty and efficiency of such protection must be checked constantly. Those hazards that are peculiar to the operation of on-track equipment include collisions with other units; the fouling of clearances on adjacent tracks; impact with vehicles at grade crossings; collisions with motor cars or other maintenance units operated on the track; the swinging of derrick booms en route, etc.

Examples of interference with normal train operation by the use of on-track equipment are familar to all of us. On-track pile drivers, in addition to the period of driving, require time to clear the main track. The time of driving with such equipment includes the raising and lowering of the leads, whereas off-track equipment merely swings away from the track to clear it. Large air compressors installed on cars require the building of spur tracks at work sites, and either long air lines or the use of locomotives, with consequent interference with operation.

All on-track equipment, such as generators, air compressors, concrete mixers, etc., must be taken to the work site, with the accompanying interference and hazards from train movements. When major work is done on any main-track structure, some interference with normal work operations is to be expected. On-track equipment increases the extent of such interference by the aggregate amount of time required to clear the main track, plus the additional time required to complete the entire job, due to the smaller amount of work accomplished while the equipment is not able to operate. Furthermore, on-track equipment, particularly the large, heavy units with concentrated loads, does not lend itself readily to conversion to off-track equipment.

Driving Piles with a Crawler-Mounted Converted Dragline

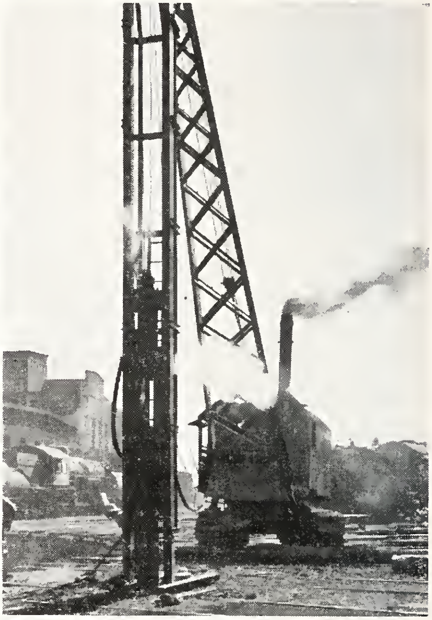
Crawler-Mounted Dragline

The use of the crawler-mounted dragline, which is readily converted for use as a crane or pile driver, has become universal where the character of the work permits. The conversion to a pile driver is effected by adding leaders and the use of a drop hammer which is operated from the same drum that ordinarily handles the excavating bucket. Where a steam hammer is required, an auxiliary boiler can be placed at the work site to furnish steam.

One of the accompanying views illustrates the driving of piles during the reconstruction of an overhead highway bridge. This same crawler-mounted converted dragline was used to remove the old bents and to install the new timber. Frame bents, instead of pile bents, were installed similarly in some instances. This type of equipment has also been used to drive piles to stabilize embankments. On another job, involving the reconstruction of pier footings adjacent to an operated track, a dragline converted to a pile driver, supplemented by a stationary boiler to supply steam for the hammer, was used successfully to drive steel, timber and sheet piles. By removing the leaders and hammer and equipping the unit with a clamshell, the same machine did all the excavation necessary, the excess material being hauled away on trucks. The same machine was also used as a crane to handle all heavy construction materials.

Another view herewith shows a steam ditcher, equipped with crawler treads, converted to a pile driver, operating a steam hammer that is driving foundation piling for a new turntable circle wall. The same machine can be further converted for excavating work.

The design and type of structure affect the method of construction and the procedure to be followed. The use of preframed timber in bridges and trestles permits its rapid installation with a crane. The use of power-driven tools for installing hardware speeds up the work, as well as makes for uniformity in construction and reduces the time that slow orders must be in effect. Precast masonry units of relatively small weight can often be placed with off-track cranes. The use of culvert pipe that can be jacked through embankments may obviate the necessity for falsework needed for building a concrete box. The addition of steel, by welding, where feasible, to strengthen bridges, saves falsework. The use of power tools to remove old masonry in connection with the placing of grillages and the repair of concrete bridge seats should not be overlooked.



Steam Ditcher, Equipped With Crawler Treads, Converted to a Pile Driver

The driving of steel sheet piling around pier footings as a protection against scour, can often be done entirely by off-track equipment. The building of a sheet pile retention dam downstream from a bridge will generally stop further erosion of the stream bed at the bridge site. Masonry culverts of early design are often without floors or paving; these may be repaired by filling between the footings with local riprap, grouted securely in position.

The use of jets in driving piles, while not novel, is frequently overlooked. The application of crib walls may reduce the length of bridge needed. The above are but a few suggestions, but they serve to show the need of forethought in design.

Power-Driven Tools

Although the scope of this subject does not include power-driven tools, the use of such tools is so closely allied to the use of off-track equipment that attention must be called to them. Hand or gas-engine-operated cranes of one to five tons capacity may obviate the need of cranes of larger capacity, of either on-track or off-track types.

Gas-engine-powered cranes, similar to those used on highway wrecking trucks, can be used in deck renewals and bridge repairs and replacements. This type of crane is especially useful in removing drift from about structures during periods of high water. Its mobility permits a choice of location, such as on the bank of the stream, on the track, on a push car, or on a bridge pier. It can be moved over the highway to points of trouble that cannot be reached by on-track derricks because of intervening washouts. To repair simultaneously many breaks in the track, permits earlier resumption of normal train operation.

The two principal machines used by bridge forces that are operated on the tracks are the pile driver and locomotive crane. Obviously, these machines cannot be dispensed with entirely, because there are many jobs to which they are specially adapted. Thus, a certain minimum number of such machines must be maintained to meet emergencies. Railroad officers should, however, restrict their use to actual needs, and where justified. Such a policy will probably reduce the number of on-track machines retained in service and permit the purchase or rental of modern off-track equipment.

Even the motor car is subject to study for replacement with trucks. Men traveling to work by highway are not delayed enroute, and they arrive at the work site in proper condition to take up their work. To state that trucks can replace work trains entirely would be absurd. However, most types of work proceed on highways without work-train service.

Other Off-Track Equipment

In territory where suitable local materials meet specifications, it may prove profitable to install relatively small production units, such as portable crushers, sand and gravel production units, etc. The material can be trucked to work sites and stock-piled, avoiding the use of work trains, special equipment, and possibly train hauls from distant established producing plants. With the increased carrying capacity of trucks and trailers, it is now possible to transport large units of fabricated bridge steel, at least for short distances. This situation makes it possible to unload steel and other material from cars at the nearest siding, and tc transport them to the work site without a work train.

Even the use of side-dump cars for hauling aggregate should be studied. It may prove cheaper to unload crushed stone, sand, etc., from cars at a nearby siding, with a crawler clamshell, and move it to the site of the work in dump trucks, than to use self-cleaning cars with a work train. Dump cars restrict the location of stock piles at the site of the work to points adjacent to the track, whereas, if the work site is accessible to trucks, the choice of stock pile locations is broadened, and the hours of productive work are not limited to the time that the unloading work train can remain at the work. Where two daylight shifts are employed, the use of work trains requires either two trains or excessive overtime for one train.

The use of a clamshell or derrick for unloading material from cars to trucks may facilitate car service, for in such cases the use of self-cleaning cars is not imperative, and gondolas may be substituted for flat cars where the length of the material handled permits this. The use of trucks where excavated material must be hauled away hardly needs comparison with the use of a work train and dump cars. Where trucks are used, the work can proceed without interruption, and there is practically no expense involved for the disposal of the excavated material.

The officer in charge of any project should study the possibilities of substituting trucks for other types of equipment, having in mind their many and varied uses, flexibility of operation, and continuous operation without the long idle periods experienced by on-track equipment. At the same time, improvement in on-track equipment, or the use of auxiliary machines to reduce the amount of time that on-track equipment is in use, should not be overlooked.

Many projects, where piles are to be driven in an embankment, are advanced by the use of earth augers prior to driving the piles. Such augers may be attached temporarily to pile driver leaders or operated separately as off-track equipment. This practice insures better vertical alinement of the piles and may obviate re-driving or construction of frame bents after embankment has been excavated.

Water-borne equipment, which includes pile drivers, dredges, power plants, etc., should not be overlooked where the project is so located that this type of equipment is economically available and its use practicable. Its use, however, is generally limited to navigable streams, canals, lakes and seaboard areas.

While the subject of this report embraces only the use of machines, we should not overlook the study of old-fashioned methods, which, in some cases, may prove the least expensive. Many times engineers have called out one or more wrecking derricks, with full crews of car men and one or two train and engine crews, to unload and place girders which could have been placed at less expense by hand methods, even though the latter might have required a few extra days.

Telephone communication over commercial lines has often enabled supervisors to keep in touch with work without depending upon conductor's work-train reports or the regular railroad circuits. On work where its importance justifies, a telephone should be installed so that the movement of off-track units of equipment can be directed and controlled. The use of railroad circuits should be discouraged. Many roads have labor agreements which restrict the use of company wires to regular operators, except in emergencies, and even then the roads may be required to pay for work not performed if their lines are used by other than operators.

Objections to Off-Track Units

There are objections to the use of off-track equipment, which must be given due consideration when planning methods of carrying out a project. All users of trucks and automobiles must have and pay for the various licenses required. These include truck or car licenses in each state in which they are operated, driver's licenses, ad valorem taxes, city licenses, liability insurance, etc. Off-track equipment, in some states, is also subject to inspection, with the accompanying fees that are not required for on-track equipment.

The use of off-track equipment does not mean necessarily that railroads should overstock such equipment, any more than that they should not purchase any off-track machines. Judgment must be used in the purchase of any equipment. Off-track machines are often available at reasonable rentals, with or without operators. Minor repairs can be made by the machine operators, and parts are usually readily available at nearby garages. A study of the methods employed by successful contractors is well worth the time of all railroad officers.

The present preparation of the country for defense has increased traffic density and shortened train schedules, and we can expect still further shortening of schedules. The use of locomotives, cars and other equipment has been intensified. The interference with revenue train movements by work trains and on-track equipment is more serious today than it has been in the past. Therefore, it is the duty of maintenance officers to overlook no factor which will enable operating officers to obtain their objectives in train performance.

To compare the costs of projects carried out by off-track and on-track equipment, completion report cost figures for the work done with one type of equipment must be compared with an estimate of the cost of doing the same work with the other type of equipment. Statistics, without a complete picture of a project, are often misleading. This should be borne in mind in this report, because the committee has accepted and incorporated statements of a number of individual members of the committee and other railway officers as to the economy of using off-track equipment, without specific supporting data.

It is the conclusion of the committee that the use of off-track equipment is not only possible, but that it is highly desirable and economical in many instances. Individual initiative on the part of officers will, in general, determine the scope of its use. In connection with the use of such equipment, the committee suggests that the following points be observed.

(1) Design structures and prepare plans and specifications that will invite the use of off-track equipment.

(2) Co-operate with manufacturers to improve machines and widen the scope of their use.

(3) Study and originate methods of application of (a) existing off-track machines; and (b) the use of on-track machines to reduce the extent of their use.

(4) Do not use on-track equipment unless (a) it is warranted economically; unless (b) off-track equipment is not available; unless (c) emergency requires its use; and unless (d) the location and work forces its use.

(5) Select proper, competent and interested operators.

DISCUSSION

President Church: This is a new and interesting subject and we would like any supplemental data which may be offered, or questions which may be answered.

R. E. Caudle (M. P.): Mr. Livingston and his committee have prepared a very complete report and it has been ably presented.

On our lines, many of our structures are inaccessible to highways. Therefore, we must, of necessity, transport our work equipment to and from the job on the main track. During the last few years, we have worked out a plan whereby we keep slow orders to a minimum by working on only one bridge on a district at a time. When we start to drive a bridge, we have the gang drive and deck the bridge as quickly as possible. If the structure is a long one, we move in the regular district gang to facilitate the work. In this way we seldom have more than one bridge on a subdivision at a time covered by slow orders. Where traffic is heavier in the forenoon than in the afternoon, we sometimes make a reassignment of hours for the driver gang. In that way, we keep our bridge slow orders down to the minimum at all times.

L. D. Garis (C. & N. W.): I am much interested in this report and I would like to find out, if possible, just how general is the use of this off-track equipment. So far as I know, we have very little of it on our railroad except trucks, although I may be wrong.

This question of train crews having superfluous men on jobs is evident on the North Western, as I suppose it is on all railroads; although in conversation with our supervisors, I find little criticism of the idea of having a conductor with on-track equipment. As a bridge inspector, my work equipment consists of a very light motor car, and when I am out on these real "hot" lines, with a line-up of about 15 trains on them, I sometimes wish I had a conductor with me.

If we were to use this off-track equipment spoken of, I don't see how we could be sure that some day the crafts might not insist there be a conductor and an engineer on it, as, for example, on an off-track pile driver.

Avoids Lost Time

President Church: The chairman cites examples where off-track pile drivers with leads and supplemental equipment may be used. I would like to ask him what uses have been developed in that respect?

Chairman Livingston: We have found that off-track equipment lends itself to the driving of piles in overhead highway bridges, where, obviously, the bents close to the track are the only ones that would be driven by an on-track driver. Piling required in the vicinity of a bridge or around piers or abutments, where the location lends itself, can be driven with off-track equipment.

As to the point made about the use of pilots or conductors for off-track equipment, I think it best to let the crafts bring that up. There are very few things they have overlooked when it comes to making work.

The big advantage in using off-track equipment, aside from avoiding payment to operating employees for non-gainful work, is the fact that when you clear for a train, you can work up almost to the time the train is due at the work site. When the train has passed, you immediately resume operations, whereas, with on-track equipment, you have to lower your leads, because usually there are overhead clearances that will keep you from going into town with the leads up. Obviously, all of that increases the time on the job. Your men who are actively engaged in the work at the bridge are, at least theoretically, idle during the period the machine is absent. The object of this report is to set us thinking and sort of challenge the methods we have been using. If we don't stop and take stock occasionally — at least, that is the viewpoint of the committee — we will never make any progress. The mere fact that we have been doing things a certain way since "eighteen hundred something," whenever the railroads were built, is no definite assurance that that is the best method.

Only One Slow Order at a Time

While I am on my feet, I might comment on Mr. Caudle's remarks. The practice of setting up slow orders on only one structure on a subdivision at a time is a very good one, and we have given that some consideration. However, sometimes the volume of work on a subdivision is so large, with so many bridges involved, that if you took them one at a time, you wouldn't get the year's work done. You have to face that. But those are problems that have to be worked out by the local officers. It is obvious, of course, that if we didn't have some slow orders, we wouldn't get our work done.

Also, in connection with that, we have conducted a campaign of driving a little better falsework than we have in times past. I think it has been the common practice to drive falsework and then keep the bridge gang there shimming up to keep the track safe for say, even a five- or ten-mile-an-hour order, whereas if we drove our piling in the first place as though we were putting in a permanent bridge, it would cost us a little extra, but we would sleep better nights while the work was in progress.

Much of the report, of course, draws on our imagination, because of the fact that so much remains to be done in this field to get equipment off of the track and out of the way of train operation. The primary purpose of the railroads is to transport personnel and material, not to build bridges or relay rail. Those are only a means to an end. It is the function of the maintenance officers of the railroad, in my opinion, to see that that work is done in the most efficient and adequate manner, and with the least interference with traffic.

Chinn Cites Five Advantages

Armstrong Chinn (Alton): Mr. President, I think Mr. Livingston and his committee are working in the right direction. Unquestionably off-track equipment is going to be given more study from now on. As expenses go up on the railroads, the maintenance man will need to find ways to get more out of his maintenance dollar. Where off-track equipment can be used and is adaptable to the work, I think he will get more out of his dollar when he uses this equipment than when he uses on-track equipment. There are five good reasons for that:

First, off-track equipment does not require an expensive work train.

Second, as things stand now, extra men are not needed on off-track equipment. That reduces expenses.

Third, off-track equipment can

work more continuously. As pointed out by Mr. Livingston, time is not wasted running into and out of sidings to get in the clear of trains. Maybe, if the equipment is working within the track space, it swings its boom out to clear while a train passes. As soon as the train has passed, it is back on the job.

Fourth, being off-track, the equipment doesn't interfere with fast schedules. Nearly every railroad in the country is now running trains on very fast schedules, and a three- or four-minute delay, or even the slowing down of a train, is a serious handicap. I made some tests when we were putting our trains on fast schedules and found that bringing a fast train to a stop and then accelerating it back to normal speed results in a loss of three to five minutes as compared with running through at scheduled speed. Three to five minutes lost at several locations in a fast schedule may result in the train arriving late at destination.

Fifth, off-track equipment is usually adapted to several kinds of work. As pointed out by Mr. Livingston and his committee, a crawler crane can often be used to drive piles, for ditching and for handling material. When a machine is adaptable to several kinds of work, it can be employed more continuously, and thereby produce a greater return on the money invested in it.

Proper Design Necessary

At another place in the report, Mr. Livingston and his committee point out the desirability of structures being designed correctly. I think that is important. I have in mind one job on our railroad where we were required, as the result of a lawsuit, to put a larger opening through one of our fills. We had had one of those unusual cloudbursts and adjoining farm land had been flooded for the first time in the history of the railroad; but, nevertheless, we had to put in the larger opening through the fill.

Our standard practice for that type of job normally would have been a concrete box culvert. The fill at that location was 30 or 35 feet high, with several tracks on top, and whatever type opening was put through it would have required a length of 160 feet. Our bridge engineer made an estimate of $35,000 as the cost of putting in a concrete box culvert, with the necessary falsework. This would have meant slow orders for our trains as long as the falsework was in position.

All this was about the time the pipe culvert people were advocating jacking pipes through fills. I knew of no location at that time where pipe had been jacked through 160 feet of fill, but I decided we would try it at this location. So, instead of putting in the concrete box culvert, we jacked a corrugated pipe through, at a cost of $5,000, and without any delay whatever to our trains.

To my mind, that illustrates the need for careful design of the system used at any location.

President Church: I might supplement the remarks made on the desirability of coordinating the use of this equipment. If we have crawler-type bulldozers and other such machines for excavation work, it is possible that it could be used for tamping and other miscellaneous work.

An item of progress in bridge

work came to my attention on the Seaboard recently, where they had close overhead clearance for driving piles. Here, they used tubular piles cut in sections as small as three feet long, which were driven as a foundation. As the short sections of tubular piles were driven, additional short sections were welded on top and the driving continued. It would have been very difficult to have driven long piles with equipment rigged up on the track. This idea may work in other places.

The question of slow orders, of course, is going to demand that we make use of all kinds of methods to prevent their being used more than is absolutely necessary. I recall that during World War I we were required to do everything possible to eliminate not only slow orders, but work-train service as well. We probably will have times when we will not be able to get work trains due to the scarcity of engines, men and everything else. At other times, the operating department will insist on avoiding any interruption of traffic.

If no one has any further comments on his report that he feels is particularly pertinent, we will dismiss the committee with our thanks for their excellent report.

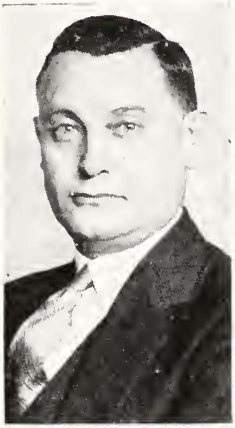
Maintaining Forces in a Period of Widespread Demand for Skilled Labor

By P. O. Ferris

Chief Engineer

Delaware & Hudson, Albany, N. Y.

(Introduced by C. Miles Burpee)



P. O. Ferris

C. M. Burpee (Ry. Eng. & Mtce. Cyclo.): Mr. President and gentlemen: The personnel of the bridge and building forces is fully as important as the materials and machines used by the maintenance department. Particularly at this time of national stress, the consideration of forces takes on even greater importance to all of us.

We are particularly fortunate to have in our next speaker a man who is well able to discuss the subject which we have before us this afternoon. Mr. Ferris, after being graduated from Rensselaer Polytechnic Institute, served for a short time as instructor at his alma mater, and then joined the engineering staff of the Delaware & Hudson. During his more than 24 years of service with this road, he has been actively associated with the maintenance department in several different capacities. As supervisor of track, roadmaster, assistant engineer of maintenance, division engineer, engineer of maintenance of way, and now as chief engineer, he has been intimately associated with the labor problems on that railway.

The Delaware & Hudson was one of the first railways of the country to create means for maintaining year-around forces in the maintenance of way department, and particularly for handling bridge and building work. Its efforts in this regard were begun more than 20 years ago, and Mr. Ferris has been associated with all of the developments from that time until the present. It is my pleasure at this time to introduce to you P. O. Ferris, chief engineer of the Delaware & Hudson.

Address by Mr. Ferris

Mr. President and members of the Bridge and Building Association and guests:

I need not say, I am sure, that I am honored, and that it gives me great pleasure in having been asked to address your splendid association. I also want to mention that the Delaware & Hudson Company some few years back was honored in having on its staff a former president of this association. I refer to the man who has just introduced me.

I could say many nice things about Miles. I have been associated with him for many years, both in a business way and, I might say, socially. I have missed Miles very much, and I think that the Delaware & Hudson has also.

The problem of maintaining forces is always serious and important, but it is especially so in a period such as we are facing today. We are now passing, or have passed, from a period of major depression to one of prosperity, or almost complete recovery.

This recovery of business has come about not because of re-adjustments in industry due to changes in methods of production, nor to changes in transportation, manufacture or merchandising. It is true that all these have played an important part, but the real cause is the stimulation of business due to the present war. This war stimulus has created demands calling not only for the expansion of present industries, but also requiring the creation of many new ones. The problems of production and transportation today are more numerous than ever before, and their solution requires the utmost effort on the part of capital, management and labor.

A short time ago I saw some very interesting data. These United States of ours hold an enviable position in the world. They provide nine-tenths of everything we need. Most of what is imported may be considered luxuries. Here, we have 6 per cent of the population of the world and less than 6 per cent of the land area, and yet

The Need for Mechanized B. & B. Forces Is More Urgent Today Than Ever Before

we produce 72 per cent of the world's supply of oil, 37 per cent of the coal, 42 per cent of the iron ore, 45 per cent of the finished steel, 51 per cent of the copper, 54 per cent of the cotton, 64 per cent of the corn, and 20 per cent of the wheat.

I do not know the date these figures were compiled, but I do know that it was prior to 1941. Large as this production cited is, I have reason to believe that it has increased considerably, since we are now trying, as never before, to furnish ourselves and the rest of the world with munitions and other supplies. In view of this, is it any wonder that we are confronted with a labor problem?

Industry Seeks Our Men

The railroads are the prey of almost everything under the sun: Depression, diversion, taxation, regulation, subsidized competition and politics. In addition, in times like these, they are the prey of other industries, especially defense industries, for their skilled labor. Most classes of the skilled labor demanded by other industries are to be found in the bridge and building departments of the railroads.

The railroads have between four and five billion dollars invested in their bridges and buildings. Normally, more than 100 million dollars are spent annually on their maintenance. The proper organization and retention of the skilled forces in the bridge and building department are, therefore, matters of considerable financial importance to us all. The workmen in these forces may be divided into three groups:

(1) Those exceptionally satisfactory, which, if lost, are hard to replace.

(2) Those sufficiently satisfactory to be retained, but not hard to replace.

(3) Those of undesirable character, poor or unstable habits, and discontented minds, who are troublemakers.

Those in the last mentioned group are tolerated only until their traits are discovered, or during times of great industrial activity.

How Can We Hold Best Men?

How can we secure and hold men of the type in the first group, and guard against men of the type included in the last group? I believe the solution lies in reducing our forces to a point so small, consistent with proper maintenance, that those retained can be employed continuously, the year around—a force so small that it will be unaffected by financial reverses.

How can this be accomplished, and yet maintain our structures properly? It can be done by removing unnecessary structures; by building for permanence; by mechanizing our forces wherever it is economical to do so; and by contracting our major projects.

A careful study of our properties will reveal numerous structures of various kinds that are unnecessary, or structures that can be made unnecessary by combining their functions with those of others. Starting in 1922, such a study was made on the Delaware & Hudson, which resulted in the abandonment of 47.8 per cent of our freight and passenger stations, 32.1 per cent of our water stations, 36.8 per cent of our turntables, and 36.4 per cent of our other miscellaneous buildings — a combined total of 37.3 per cent of all such structures.

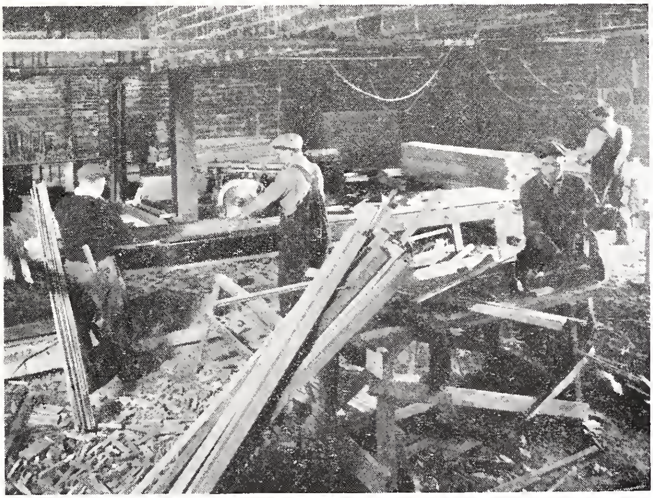
I do not have to tell you what can be done regarding more permanent construction in railroad work. Briefly, it involves using the best materials available, consistent with the expected life of a structure. The initial labor cost to install good materials is little, if any, more than the cost of installing poor materials, but the resultant saving in maintenance labor is considerable.

The subject of the mechanization of bridge and building forces was handled very ably in a report of one of your committees last year. I shall not attempt to enumerate the various units of labor-saving equipment and power tools that are now available for mechanizing bridge and building forces. However, the necessity for this mechanization to augment the production of your present forces is more urgent today than ever before. If those in the bridge and building department are equipped properly, regular or ordinary maintenance can be handled satisfactorily with a minimum force.

Projects of major proportions should be contracted. With proper specifications and, of course, efficient inspection, the work on such projects can be completed with entire satisfaction. By so doing, the regular forces can carry on without interruption, and without deferring ordinary maintenance.

Stabilize Forces

From what I have said, you will sense that I am advocating what is, in reality, the stabilization of bridge and building forces, and have suggested a method of accomplishing it. With regard to the stabilization of forces, I can refer proudly to the originator of that system on the Delaware & Hudson, the late H. S. Clarke, engineer, maintenance of way, with whom I had the honor to be associated for many years. I have tried to continue many of his maintenance pol-



Power Tools Will Offset Losses in Labor and, at the Same Time, Effect Substantial Economies in Doing Work

icies, and the stabilization of forces is one of them.

We have had very little trouble keeping our bridge and building forces stabilized. We have a bridge and building department on each division under the supervision of a bridge and building master, or supervisor, who reports to the division engineer, who, in turn, reports to the chief engineer. In addition, we have a system steel bridge department, a system, and not divisional department, under the supervision of a general foreman, who reports direct to the engineer of structures, who, in turn, reports to the chief engineer.

Our steel bridge department, which includes a small shop gang and two fair-size road gangs, is equipped with a small, well-equipped shop. The road gangs are housed in exceptionally comfortable camp cars and cover the entire system. They work on steel alone, and are equipped to take care of all steel maintenance work, as well as the erection of new bridges, if required. We, however, contract major bridge erection jobs. There has been no change whatever in the personnel of this department for more than 12 years.

The division bridge and building department forces, although stabilized, have been reduced approximately 30 per cent as the result of abandonments, careful planning of work and mechanization, and by contracting major projects. I believe that now, however, through the addition of more power tools and equipment, we have a minimum force consistent with average maintenance.

Long Service Records on D. & H.

Most of our bridge and building employees have been with us for many years, as will be evident from the accompanying table.

From these tabulations, it is seen that we have had little, if any, trouble in maintaining the bridge and building forces on the Delaware & Hudson. We have several

Record of Service of Bridge and Building Foremen, Skilled Workers and Helpers on the Delaware & Hudson

Foremen

(Foremen are promoted from the ranks)

Service Record		Ages	
Youngest in service	3 yr.	Age of youngest	39 yr.
Oldest in service	41 yr.	Age of oldest	66 yr.
Average	20 yr.	Age of average	54 yr.

Skilled Workers

Youngest in service	2 yr.	Age of youngest	29 yr.
Oldest in service	43 yr.	Age of oldest	67 yr.
Average	16 yr.	Average	46 yr.

Helpers

Youngest in service	1 yr.	Age of youngest	32 yr.
Oldest in service	22 yr.	Age of oldest	58 yr.
Average	14 yr.	Average	41 yr.

The average age of all bridge and building employees is 45 years.

major defense industries on our lines and numerous other industries, but, in spite of this, I am able to state that, to date, we have had no losses which could not be replaced. There must be some reason for this.

Steady Employment Desirable

There is something fascinating about railroad work, regardless of the department. All of us, no doubt, have had attractive offers to leave our railway at one time or another and have turned them down, or, if they were accepted, have returned to railroading when the opportunity presented itself. Some of our workmen, no doubt, were attracted to railroad work because of this fascination, but most of them entered railroad employment because of many other reasons.

One of the drawbacks to securing and retaining good skilled employees is the uncertainty of steady employment. Although it may be necessary to reduce forces at times during the winter months, a reputation should be established for employing an average force the year around. Bridge and building work can be so planned that it can be distributed over the year with efficiency and economy. Work such as the painting of the interiors of buildings, repairs to freight house, shop, and enginehouse floors, and many other interior repairs, can be done satisfactorily in cold and inclement weather. Therefore, get a reputation for providing year-around employment.

The building industry and many manufacturing industries do not have such a reputation and, although their hourly wage may be higher than that on the railroad, the average employee, in the last analysis, is concerned primarily with the amount of regular pay on which he can depend.

If possible, hire men from the smaller communities, rather than from the cities. Men in the smaller communities have usually learned how to work. All that is necessary is to train them. Wage rates and the cost of living are lower than in the cities, and railroad labor rates are, therefore, attractive in comparison.

When men are away from home, provide them with good living quarters, and permit them to return to their homes over week-ends. On our railroad, we provide camp cars equipped with lighting and heating systems and a fully-equipped kitchen and dining room. Sleeping cars and bedding are provided for the workmen, dormitory style, with separate quarters for the foremen and the cook. Shower baths are also provided by means of a small converted locomotive water tank.

The foreman is in complete charge of the camp and is responsible for the cleanliness of the cars and the conduct of the men. The cost of meals is divided equally among the men and they all have a voice in what will be served. Camp living expenses are thus, very small. We permit the men to go home week-ends, and any time that is lost as a result, is made up by working extra time on regular work days.

Use care in the selection of your men, not only from the standpoints of age, health and physical qualifications, but also from those of character and disposition. A man of poor character, or one with a disagreeable disposition will, sooner or later, become a trouble-maker and spoil the discipline of an entire gang. Having once hired a man of this type, he is hard to get rid of—so choose your men with care.

Create a first-class safety-first organization. Have as many men as possible take an active part in it. Hold periodic scheduled meetings. Invite different foremen and men to attend. Have safety agents contact the men at work occasionally for short safety talks. Inspire your regular men and your prospects with the fact that employment in a bridge and building gang is safe employment.

Have a standard and fair discipline system, uniform throughout the entire railroad. This will assure that all of the men are treated alike, and will aid you in retaining your regular men and in attracting new men. It will also prevent many claims on the part of the labor organization.

Select Officers Carefully

Choose supervisory officers and foremen with reputations for experience, intelligence, and unquestioned disposition and character. The abuse of employees by officers or foremen should not be tolerated. Good men will endure it only under circumstances that compel them to. They will not endure it when employment is open elsewhere. If your road gets a bad reputation in this respect, it will be not only hard to retain men, but just as hard to hire new men. If you have supervisory officers who abuse their men, their services should be dispensed with, because they can be very damaging to the company's interest. You must have officers whom workmen respect.

Promote foremen, and at least some of your supervisors, from the ranks. Let your employees know by this action that there is a chance for their advancement; a premium for faithful and efficient service. Furthermore, supervisors should have personal, frequent and friendly contact with their men.

It is an easy matter to impress men with the advantages of railroad employment. Men get a great deal better training in railroad work than they do in ordinary industry. They have an opportunity to see and do more special kinds of work under a wide variety of conditions. The work, generally, is not hard. There is, almost daily, travel time (at company expense) free from manual effort, as contrasted with similar positions in outside industries where a full eight hours of productive labor is expected, doing the same thing day after day. There is something new and different almost every day in the work of a railroad bridge or building crew.

Railroad work is healthy and safe. There is the opportunity for railroad workmen and their families to travel by rail at no expense. They are protected in old age by pensions. Although the work is seasonal, there are no drastic reductions of forces as in the building industry. The workmen we desire to hold can be convinced that the working conditions and high wages being created in other industries at the present time are artificially maintained, and are of uncertain and, perhaps, short duration.

If this is brought to their attention, your men will recall the past years of unemployment and the many victims of the depression.

They will recall the financial reverses that are bound to follow such periods as the present. They can be told that railroads have a record of steadiness. Business, at present making steady advancement, may suddenly stall. The railroads, like the rivers, go on forever. The type of workmen we desire can be convinced, regardless of other demands for their services.

We are now all being put to the test, and remember that one test of executive talent is the ability to secure and retain the services of satisfactory employees.

DISCUSSION

President Church: We certainly thank you Mr. Ferris for your most interesting address. Before you get away, I would like Mr. Chinn to make a few comments on your paper.

Armstrong Chinn (Alton): I think Mr. Ferris certainly hit the nail on the head in his paper. In substance, what he said was, "Make the worker secure in his work and make him comfortable and happy"—and he told us in detail how to do that. If we do do that, I am sure we shall have no difficulty in getting the number and the kind of men we need on the railroads.

I find that this prevails on our railroad. We have a couple of large ordnance plants on our line, and we are not being troubled at all losing men to these plants. I think it is because the men realize, as pointed out by Mr. Ferris, that the railroads offer them something in employment that they cannot secure elsewhere. They offer them steady employment; they offer them reasonable wages, they offer them work that is not too difficult or too hard; and they offer them care in their old age, with a reasonable pension. I think these are all things that any man who does a little thinking, wants. I know the men on our line do, and I am sure they do on Mr. Ferris' road.

President Church: Is there anyone else who would like to speak on this subject? If not, Mr. Ferris, thank you very much.

Mr. Ferris: It has been a pleasure for me to come here.

Maintenance and Repair of Bridge and Building Equipment

Report of Committee

Martin Meyer, *Chairman*, Supv. B. &. B., C. & W. I., Chicago; F. E. Taggert, *Vice-Chairman*, Asst. Engr., I. C., Chicago; W. A. Batey, System Brdg. Insp., U. P., Omaha, Neb.; J. H. Brandt, Supv. B. & B., C. & O., Columbus, Ohio; W. W. Caines, Brdg. Insp., C. & O., St. Albans, W. Va.; J. J. Clutz, Div. Engr., Penna., Indianapolis, Ind.; D. W. Converse, Asst. Engr., A. C. & Y., Akron, Ohio; R. W. Cook, Gen. Brdg. Insp., S. A. L., Norfolk, Va.; H. E. Davis, Brdg. Insp., N. Y. C., Chicago; R. W. Johnson, Asst. Engr., C. M. St. P. & P., Chicago; S H. Knight, Supv. Work Equip., N. P., St. Paul, Minn.; C. Kohler, Supv. B. & B., Erie, Cleveland, Ohio; W K. Manning, Gen. Brdg. Fore., Erie, Cleveland, Ohio; A. Monson, Supv. B. & B., N. P., Glendive, Mont.; and A. J. Moore, Brdg. Insp., M. P., Eunice, La.

Martin Meyer
Chairman

This subject is a very live one today. The mechanization of bridge and building gangs is of comparatively recent origin, but it has expanded so rapidly that the proper care of equipment has become of major importance. It has been handled on the railroads, for the most part, like "Topsy"—it "just growed"; and bridge and building officers are aware of the resultant inconsistencies and abnormal developments that exist in this regard, as they always are of anything that "just grows."

That there is a real necessity for the effective and efficient maintenance of such equipment is beyond question. The investment in equipment must earn a profit, and this profit must not be lost by inefficient machines, costly delays to large gangs, accident and injury expenses due to machine failure, unnecessarily large expenditures for repairs, or shortened service life due to improper care. An idle machine is a frozen asset and a broken-down machine is an actual liability. We all know what it means to have a machine fail, and to have to resort to hand labor and obsolete methods to complete a job—the added cost, the additional time required, and, in some cases, the impossibility of completing the job until the machine is repaired or replaced with a similar unit. This is extremely serious when it interferes with the movement of trains.

Systems Vary

Many roads have made extensive studies and have established expertly engineered systems to acquire the high standard of machine maintenance necessary for dependable performance. These systems vary greatly in their organization and personnel, and in the way they "tie in" with other departments. On some roads all repairs to all types of equipment are made by the mechanical department. On others, only extensive repairs to heavy work equipment are handled by that department, and repairs to other types of machines and tools are made by various other departments.

A few roads have organized special departments exclusively for this purpose. The activities of these special departments are under the direction of the mechanical department on some roads, while on others they come under the engineering department. Such a special organization, directed by the maintenance engineer and having a personnel specially trained for the work it has to do is, without doubt, the ideal. It requires considerable investment for tooling and housing, but, on large roads with many items of equipment (sometimes numbering many thousands), such an organization is justified. It offers many advantages. Its primary purpose is the maintenance of work equipment, and it is only reasonable to expect that the results secured will be better than those obtained in a department in which such work is secondary. Its men are more familiar with the design and construction of the machines they work on; in fact they are, or become, experts in its repair. Furthermore, they are in closer contact with the equipment and, therefore, are in a position to know how it is used and what is expected of it. The work of such a special organization can be programmed to the best advantage of the department using the equipment.

Where the size of the road or the number of units to be maintained is not large enough to justify such a special department, the next best arrangement is for the mechanical department to perform the heavier repairs and complete overhauling work, thus eliminating the expense of the larger items of tooling and housing. This has the decided disadvantage of dividing the responsibility for the proper maintenance of the equipment. Furthermore, with the mechanical department, the work is secondary in importance to the maintenance of operating equipment. Most small roads have found that, from the standpoint of investment and cost, it is necessarily best to have the shop repair of their equipment handled by the mechanical department.

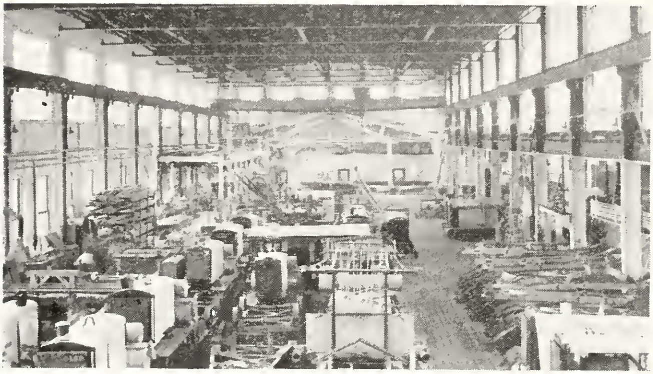
Shop repairs are, for the most part, handled on a system basis, whether they are done by the mechanical department or by a separate organization. This avoids the duplication of tooling and housing at several locations, and affords better control of operations because the repairs are centralized. In addition, cost records can be kept with greater accuracy, and the personnel can be kept more fully occupied and brought to a higher degree of efficiency. The great distances that equipment must be shipped on the longer roads under such a system shop basis, however, with the loss of time and the expense incurred, have prompted some roads to establish several shops, strategically located. Under such conditions, duplication of tooling and housing can be justified. In fact, in the case of the larger roads having a large amount of equipment, some argument can be found for handling its repair even on a division basis.

Programming Repairs

Considerable effort is being directed toward programming equipment repairs, but it seems quite evident that an absolutely rigid program cannot be adhered to. Identical machines will not require identical repairs in an identical length of time; and it does not seem practical, therefore, to program repairs beyond that of seasonal machines that can be inspected, and the repairs found necessary made during the off-season when the machines are not being used. There is some danger of over-maintaining machines that are sent in periodically or on a definite program, because, unless supervision is keen, there might be a tendency to completely overhaul them when their condition doesn't warrant the expense.

From a practical and economical standpoint, there should be no necessity for sending a machine into the shop so long as it is performing satisfactorily. It would seem better to direct more effort in the direction of periodic inspections of all machines, rather than toward programming repairs; and men trained to make these inspections should be made available on roads having many and complicated machines, because the average supervisor is too occupied with maintaining the railroad to have the time necessary to make thorough and expert inspections. The inspection should not be left entirely to the operators, because while most of them may be conscientious in this respect, many are not. Furthermore, it happens quite frequently that an operator will not report a defect if it is due to his own neglect, in order to avoid discipline; he may not want to bother with making repairs of defective conditions found; he has a false idea of economy; or he lacks the knowledge of what the correct condition should be.

There are, of course, some repairs that might be made more advantageously by the manufacturer or by an "outside" concern specializing in certain operations. This, of course, depends entirely on how completely the particular road is equipped with the necessary tools and skilled mechanics for doing the work. The average road is not in the best position to recondition pneumatic tools by building up worn pistons or reboring; to rewind and bake out the armatures and fields of electrical tools and generators; to recondition the fuel pumps and injectors of Diesel engines; or to set up and aline parts for which expensive jigs are necessary.



General View of the Well-Equipped System Work Equipment Maintenance Shop on the New Haven

Field Repairs

On roads on which a special equipment maintenance organization has been established, it is ideal to have field repairs made by mechanics who are a part of such a special organization. These men should be assigned to a particular division or territory which they can cover adequately. In the event that there is a concentration of machines at the site of a large job, these men can be assigned accordingly.

Roads that do not have a special machine maintenance organization will probably find that the most efficient, prompt and convenient way to effect field repairs is to have them made by members of the bridge and building department itself, because these men are already on the job, know all the surrounding conditions, and are under the direction of the engineer or supervisor in charge of the work. The talent for mechanical work that can be found in any group of bridge and building men is generally quite surprising, and it will usually be found that there is someone in the gang, or readily available, who can make repairs that are usually thought of as being incapable of accomplishment in the field. A possible refinement of this arrangement might be had in a combination of interest with the local roundhouse or other mechanical department facility, thus making available its talent and tools for repairs that may be a bit too much for the bridge and building department forces to handle alone. Most roads require machine operators to make minor repairs, adjustments and replacements of small parts. In practically every case, they are held solely responsible for the safe and dependable condition of their machines. They are generally furnished with a manual on the care and repair of their machines and are required to be familiar with it. This assists them in locating trouble and ordering parts, and in accomplishing field repairs on which they might otherwise have to call for expert assistance.

Need Adequate Records

The information collected by your committee indicates great laxity in the matter of keeping records of repairs. Most of us are handicapped by a lack of adequate clerical force, a situation which has prevailed throughout and since the depression, and we have been unable to gather and keep the statistics that it would be desirable and valuable to have. It is difficult to judge when a machine is costing more for repairs than is justifiable, as compared with the cost of its replacement, unless cost records are kept.

Of course, we had to be content with what we had during the depression, and most of us found it easier to worry along and keep repairing our "old relics" than to try to convince our managements that we should have new machines. But if we had had adequate cost records to show that our arguments were sound, there is no progressive management that would have attempted to "shout down" such facts. An adequate record should be kept of the repairs necessary and their cost, so that a basis can be had for exercising good judgment in maintaining our old equipment, in purchasing new equipment, and in fitting machines of proper size and power to the jobs they are expected to do. Under the artificial conditions of the immediate present, which we hope are temporary, it is, of course, necessary to continue to maintain the machines we have, because new ones are not readily procurable.

Most roads, apparently, do not have a monthly equipment report other than that required by the auditing department; neither do they have a daily performance report, other than the meager information shown on the daily time report. Such information as would be available on proper daily and monthly reports is valuable, and even necessary in the case of major pieces of equipment, and if the record system is properly designed, it should not be costly to maintain. There is a trend toward keeping such records.

Lubrication Important

The factor, above all other factors, in getting out of a machine everything that was built into it, is the servicing and general care that is given to it.

Careless neglect of a machine is inexcusable; it curtails its life, makes the necessity for repairs frequent and costly, and robs it of its dependability.

First in importance in the servicing of a machine is the matter of proper lubrication. Most manufacturers realize the importance of this so fully that they spend much time, effort and money to design the lubricating systems of their equipment properly and to determine the best kind, quality and grade of lubricant for each particular machine. If, after much research and many tests, the manufacturer makes specific recommendations on what lubricant to use, it is only fair to him and to the machine, and, incidentally, to yourself and your railroad, that these recommendations be adhered to strictly.

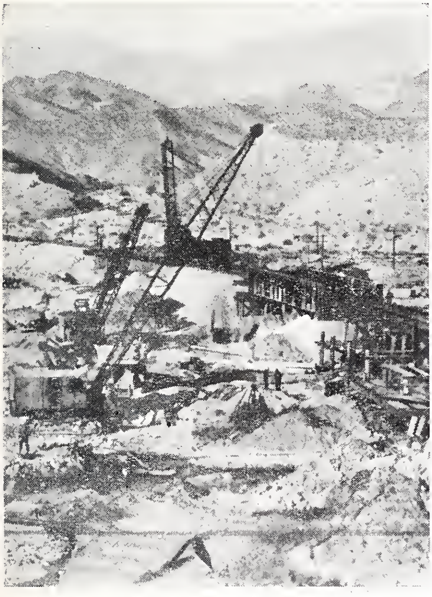
The petroleum industry has made marked advances in the scientific development of lubricants. Oil is no longer just oil, and just because a thing is "slippery" doesn't mean necessarily that it is lubricated properly. The importance of this matter of using proper kinds and grades of lubricants cannot be stressed too much in this day of modern machinery in which clearances are reduced to the smallest fraction of a thousandth of an inch; machinery, in which tremendous pressures are developed, and in which extremely high temperatures are reached. The Diesel engine would be a failure if it were lubricated with an oil having a flash-point below the high temperatures at which it must operate. The hydraulic hoist on a dump truck would be only a source of trouble if its cylinder was filled with ordinary oil, instead of a completely dehydrated oil. Pneumatic tools can be a great disappointment if improperly lubricated with a gummy oil that sticks the pistons, rotors and valves so tightly that they can be freed only by taking the tool completely apart.

A little matter of big importance, after the proper lubricant is purchased, is the way in which it is stored and distributed. One will find his purpose somewhat defeated if his lubricants are stored and shipped in dirty containers, or containers that have been used for something else, or that are not closed properly to prevent contamination. It was all right in the old days for the country store-keeper to jab a potato over the spout of your mother's "coal-oil" can, but this will hardly do today. If the facts could be known, improper containers for lubricants and fuel will, without doubt, be found to be the source of many failures of machines to operate satisfactorily, or perhaps, at all.

Lubrication should be *adequate.* Adequate does not mean that it should be applied so profusely that it runs out of bearings and gets on clutches and brakes. It means that at no time should dry metal be permitted to move over dry metal. It means that a film of oil or grease should always be maintained between moving parts to take the wear and absorb the pressure. In an internal combustion engine, it means that the proper quantity should always be kept in the crankcase. Many persons do not know about one phase of the importance of keeping crankcase oil at the proper level. The oil, in addition to keeping the engine lubricated, also serves to carry heat away from the wrist pins, connecting-rods, bearings and valves. If the full quantity is not in the crankcase, as much heat will not be dissipated, and the bearings, for instance, might expand to a point where all clearance is taken up so that no oil can get between moving surfaces, and proper lubrication is lost.

Equipment should be kept clean. Good housekeeping pays dividends with machinery as it does with everything else. Parts subject to corrosion should be kept painted or otherwise protected to prevent deterioration. Equipment, wherever possible, should be housed properly when not in use. Farm machinery manufacturers tell us that one of their greatest problems, when farmers began to mechanize, was to educate them to provide housing for their machinery and not let it stand out in the field after plowing, cultivating or harvesting until needed again the next year, only to find it in bad condition from attack by the elements. How about our railroads? Damage costing the railroads a tidy sum of money each year is done by this same kind of neglect of equipment.

On most railroads, it is the duty of the operator to see that his machine receives the proper servicing and care. This usually results in flat failure with the smaller items of equipment not handled by the same operator at all times. Machines such as small concrete mixers, concrete breakers, and tools of various kinds that are sent out from headquarters, as required, and interchanged between gangs, are almost certain not to receive proper care unless someone at headquarters is delegated to clean them up and lubricate them properly every time they come in. Each gang should have some one man delegated to take care of these small pieces of equipment while they are in use in the field.



Provision Must Be Made to Insure that all Equipment Gets the Proper Attention and Care on the Job

In spite of its importance, it seems that very few railroads keep records of any kind of the servicing done on specific machines; perhaps for the same reasons that they do not keep complete records on the repairs made. Likewise, very few roads have established any method of checking whether their machines are being serviced properly. Flagrant cases of neglect or improper care will, of course, be noticed when the machine is sent in for repairs, but otherwise we must rely upon our operators being conscientious, and upon our foremen and supervisors being watchful and alert to notice any evidence of failure in this respect. This should be one of the first things to check where a system of periodic inspection has been established. This matter of the proper care of equipment assumes gigantic importance in the face of our current national emergency, because of the difficulty, and possible impossibility, of being able to purchase replacement units, or even repair parts.

Supplies

Care must be exercised in the matter of supplies of repair parts and accessories to insure against acquiring large inventories representing considerable investment, and yet have those things available that are needed urgently when failure occurs. If a good system of records is kept, it will reveal quite accurately what parts should be stocked and the quantity that is likely to be required in a given period of time. The larger and more expensive items, such as engine blocks and crankshafts, do not fail without warning unless a machine is allowed to freeze up or run without oil, or is abused in some manner. Therefore, with adequate inspection and some foresight, these parts can be obtained from the manufacturer promptly enough to make it unnecessary to stock them on the railroad. Much valuable advice can be secured from the manufacturer on which parts are apt to play out, and these can be stocked accordingly.

If there are many units of the same model on a road, considerable saving might be realized by having a rather complete line of parts on hand; the new ones to be installed and the old ones reconditioned and returned to stock for future use, much the same as the exchange system developed in the automobile industry for the lower-priced popular cars. Stocks of repair parts are kept at a central location on most railroads, usually by the stores department, to avoid duplication of inventories and to afford better control. In the case of accessories and supplies, this also has a decided advantage in that better prices can be obtained by quantity buying.

The practice of holding to an absolute minimum supplies of spare parts and accessories kept by field crews is practically universal. Only such minor parts as breaker points, spark plugs and fan belts are supplied to field crews. This must be done, because if each crew is furnished anything and everything in any quantity, large sums of money would soon be tied up—dead money, for the most part, earning no return. A few roads report that they do not keep any spare parts with field crews because of the abuse that can so easily creep in. Cases are known where complete replacements have been accomplished by ordering a few parts at a time. In other words, if the cost of all the parts were totalled, it would be found to exceed by several times the outright purchase price of a new, up-to-date piece of equipment.

Much can be done toward reducing the variety of parts that would otherwise have to be stocked, if the practice is established of requiring the operator, or those using the machine at the time of failure, to telephone or telegraph in a list of the parts that will be required. The parts can then be secured from the manufacturer or his local outlet while the machine is in transit to the point of repair with little, if any, more delay to the machine than would be experienced if the parts were kept constantly on hand. This practice is in use on some roads with very satisfactory results. It is recognized that this practice may not work out so well today because of the difficulty of securing deliveries. Therefore, "for the duration," your committee recommends reluctantly that as full and complete stocks as possible be maintained—judgment, and not panic, dictating the quantities.

There is also the problem of what to do with any repair parts remaining in stock after the machine for which they were intended has outlived its usefulness, and has been scrapped or otherwise disposed of. They certainly should not be allowed to remain in stock, as, no doubt, is frequently the case. They should also be scrapped or otherwise disposed of, and when the last machine of a particular type is retired, the storekeeper should be informed accordingly and instructed to dispose of any parts that are usable only on such units.

The most apparent fact running

through all the foregoing is that no particular system of maintaining work equipment can be designed that will fit all of the requirements of all railroads. The physical characteristics of a particular railroad—whether it is large or small; serves an extensive or compact territory; has many or comparatively few units to maintain; its location with regard to large industrial centers; and a never-ending list of other conditions—all influence what system is best for its particular needs. Even when a definite system has been established, it must be extremely flexible so that, in case of the sudden failure of a machine, every advantage can be taken of local conditions to accomplish its repair and restoration to service most expeditiously. For instance, if a machine should break down while working on a turntable job, where a complete machine shop capable of making the repairs is located, it would be nothing short of folly to send the machine a couple hundred miles away to a central repair shop just because that particular shop had been designated as the equipment repair shop. No two cases of failure are alike, and no concrete plan will replace "using the old noodle" when failure occurs.

Recommendations

Your committee feels, however, that it can make certain recommendations. First, that you study your particular requirements and weed out the inconsistencies and abnormalties that exist in your present system, if it "just growed." Socialize "Topsy" and give her some cultural refinements.

The following is an average pattern for the average railroad, to be varied, of course, to fit any conditions peculiar to a specific road.

Shop repairs to work equipment should be made in a shop or shops independent of those used also for maintaining operating department equipment. This should include all repairs not coming under MCB rules, which repairs are probably most properly made in the regular mechanical department shops.

The activities of the work equipment shop should be directed by the engineer maintenance of way or other chief maintenance officers. Every effort should be made to avoid dividing the responsibility for the proper maintenance of equipment.

Field repairs should be made by persons employed in the bridge and building department and supervised by bridge and building officers. The field force should be complete enough to be efficient. Good work in the field will prevent the necessity of many extensive and expensive repair jobs in the shop.

A complete assortment of the required tools should be provided. There are many tools designed especially for working on internal combustion engines, which, if adopted, will increase the output materially. One would hardly expect a gas-engine mechanic to get as good results with a monkey wrench as could be obtained with a well-designed set of socket wrenches. There are many small power-driven units designed for particular operations, such as valve refacers and grinders, cylinder reborers, connect-rod rebabbetting jigs and carbon cleaning tools, that should be in every shop having a number of gasoline engines to maintain. A screw-cutting lathe, drill press and blacksmith and welding equipment should also be provided. Just how extensive the shop equipment should be depends, again, on the size of the railroad and the number and types of machines and tools to be maintained. An overhead hoist of some description is a necessary adjunct to any shop that handles the heavier units of work equipment.

The shop equipment should be housed in a suitable building with plenty of working area. An old coach or car body will hardly do. At the present stage of mechanization, housing should be designed with provision for future expansion and additional shop equipment, because the use of labor-saving machinery in railroad maintenance is bound to increase to a point where facilities adequate today will be insufficient in a short time hence. The acquisition of labor-saving machinery, it must be realized, carries with it the necessity of providing the proper facilities for caring for it.

Sufficient clerical force should be provided to maintain complete performance and cost records.

Close co-operation should be cultivated with the stores department to the end that stocks of repair parts and supplies will be kept adequate, but never excessive.

Good supervision should be provided. Nothing can take the place of a man who knows his business.

DISCUSSION

President Church: This is a very broad report, covering this subject in great detail, and I don't know just what might be said from the floor to supplement the information that has been presented to us.

H. T. Livingston (C. R. I. & P.): Mr. President, I think this is a very excellent report and the committee should be congratulated. In adopting any particular method or organization, I think that it should be kept in mind that the type of organization that might apply to one place perhaps would not be equally desirable in another. Any organization that is decided upon, however, can be made to work efficiently, and it is my opinion that that is not as important as the real objective, which is to see that proper tools are ready to work with at all times.

Many of us have been out on jobs where, we will say, the adzer or the bolting machine has broken down and it has been impossible to get it going again promptly. This may affect the production of a gang of 50 to, say, 250 men, and the cost of an entirely new machine would be less than the cost in loss of efficiency of that gang. Even in the case of hand tools, it is exasperating to go out on the job and find a carpenter trying to do a job with a dull daze or a dull saw. It is not only exasperating, but it is costly. It pays to have one of the men in the gang, a man who knows his business, keep those hand tools in shape and ready to use at all times.

Against Local Shops

So often, following an emergency, the machines that are used are merely returned to their home station and not gone over to make sure that they are ready to meet another emergency. I agree thoroughly that the repairs should be made under some maintenance officer, because it is "his ox that is gored" if these machines fail, and, therefore, he will see to it that the machines of most importance get preferred attention.

Seasonal machines, such as weed burners, mowers, etc., should be repaired during the winter months when they are not needed for actual operation. Personally, I like district shops or division shops, where machines can be given proper overhauling. I have never thought much of local repairs, other than straight operating repairs, such as attending to lubrication and wiring and things of that character. The field forces are not equipped to do heavy repair work efficiently or properly, and usually such repairs as are made are merely temporary, for the purpose of getting by. It is usually cheaper to send them a machine which is in good condition and have them send the released machine back to the shop for a thorough overhauling.

It has been my experience that most of the equipment that is sent out by the manufacturers is equipped initially with a set of tools, such as wrenches, but quite often these are lost or mislaid. In a comparatively short time, whoever operates the machine is usually asking for another set of tools. Of course, that is carelessness and should not be tolerated.

Machinery and equipment of all kinds should be ready to operate at all times. If you get a break on the main line, for instance, and you have a schedule of performance set up, allowing 1½ hours, or 3 or 4 hours, or whatever it might be, you must meet that performance, and it is very embarrassing if some machine that you are depending on to do this fails you. Unfortunately, I am sure that this has happened to most of us in this room.

It seems to me that the objective outlined here is of major importance, and it goes along with other economies in maintaining a railroad. Whatever method may be adopted, you can reach some high state of perfection in it. It is sort of like the argument of divisional versus departmental organization on a railroad. Both schemes work when they are followed up properly by the officers concerned.

Equipment Inspector Valuable

Armstrong Chinn (Alton): Mr. President, I notice two recommendations in the report which I think are good and which tie up with an incident occurring on my railroad about the time I got there. One recommendation says that "first in importance in the servicing of a machine is proper lubrication." Another recommendation is: "It would seem better to direct more effort to the periodic inspection of machines and that men trained to make these inspections should be made available."

When I came on my road, we were having a lot of trouble with motor car failures. Every time a foreman would have trouble with his car, he would send a requisition to the storekeeper for a new carburetor. I found about 140 carburetors in pretty good condition that had been sent in by foremen who had replaced them with new carburetors. Well, I knew that we were not having all that carburetor trouble and that the difficulty must lie somewhere else, so I investigated and found that the real trouble was that improper oil was being mixed in the gasoline, with the result that the exhaust ports on the engines were becoming filled with carbon, and when they did, of course, the engine lost all of its power. So the first thing I did was get in touch with the manufacturer, as recommended in the report, and find out exactly what kind and how much oil we should mix with the gasoline for proper lubrication. When we did that, the carbon trouble disappeared. Then I saw to it that no more new carburetors were sent out. If any carburetor trouble developed, we would just send out one of the good used ones that were on hand and reuse it.

Now, if we had had a man who knew his business going around making inspections, he would have discovered right off that the trouble was with the lubrication and not with the carburetors; and we would not only have gotten proper car performance much sooner, but we would have saved the expense of more than 100 new carburetors.

President Church: Mr. Meyer, this association is high in its praise of your committee for this fine report. Thank you very much. We will dismiss you with the thanks of the association.

Modernization of Small Stations to Meet Present-Day Requirements

Report of Committee

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L. C. Winkelhaus
Chairman

Within recent years, most of the railways of the United States and Canada have greatly improved their passenger equipment, especially with respect to streamlined and Diesel-powered trains. Not only has the equipment itself been improved, but the speed of travel and the comfort of passengers are such that the results have been very gratifying to the railways in the way of improved passenger earnings.

However, the appearance of the facilities at outlying passenger stations has not kept pace with the changes in the train equipment. Very little attention has been accorded such stations towards making them more attractive or comfortable for railway patrons. This is not due to lack of foresight, but rather to the curtailment of expenditures for such work during the last 10 or 15 years.

The new means of transportation provided by motor buses and airplanes are proving very competitive, and have taken a large proportion of the available passenger business from the railways. These competitive transportation agencies have provided attractive and comfortable stations for their patrons—the advertising value of which should not be under-estimated. Therefore, it behooves the railways to "wake-up" and give consideration to the modernization of some of their more important outlying stations to meet present-day needs.

Geographical Location

When preparing studies for the improvement of any station, one must give due consideration to its location, and make the improvement conform with local environments. In mountainous regions, certain innovations can be introduced to fit in with the surroundings; in summer or winter-sports regions, a different style of architecture or treatment may be in order; and at a seaside or lake region, some other treatment will be called for.

The particular community to be

served oftentimes has some bearing on the scheme of modernization. The requirements at suburban stations are entirely at variance with those at urban stations. Each project is a problem in itself, and no general rule can be applied.

When building new lines of railway, it was customary to construct station buildings at intervals of 10 to 15 miles. Invariably, these buildings were constructed of wood throughout, as this was the most convenient material available and afforded the simplest construction. Many of them have served a long and useful life, and are still in use. These stations were often constructed to provide both passenger and freight facilities, and sometimes provided living quarters for the station agent. It is almost impossible to modernize such stations.

As time passed, better structures replaced these frame buildings in the more important localities, either because of the destruction of such buildings by fire, or at the insistence of the communities served. Now and then improvements were added, such as steam or hot water heating systems, sanitary facilities and electric lighting—usually by request of the local authorities in connection with the construction of municipal water and sewer systems and the extension of electric service to the locality.

Provide Space for Other Uses

Many stations constructed prior to 1930 had two large waiting rooms, with an enclosed ticket office located between them; also baggage and express rooms located at either end of the building. Present-day practice is to provide only one large waiting room, and possibly small retiring rooms in connection with the toilet facilities. This construction has proved very satisfactory for present-day needs, and should be kept in mind when making studies for the modernization of old stations.

Oftentimes, a plan can be worked out to eliminate one waiting room, thus providing space for other uses, such as a roadmaster's office, a yard office, or additional space for an office for the express agency. It appears that in the last few years the express agency has come to the conclusion that an office in a railroad station serves their purpose just as well as an up-town office. This should be encouraged as it brings rental income to the railways, as well as more business.

In certain southern states, conditions are somewhat different with respect to providing only one large waiting room, in that it is necessary to provide separate waiting rooms and accompanying sanitary facilities for white and colored patrons.

In making alterations to a frame structure, consideration should be given first to the foundation. If it rests on pile stubs or mud sills, they should be replaced with concrete. In some cases it may be desirable to retain the wood floor system. If so, grilles should be placed in the foundation walls to provide proper ventilation. Metal termite shields should be installed in those localities where termites are a problem. A better and more permanent job, as well as a more sanitary one, would be to remove the entire wood floor system, fill with sand, gravel or cinders, and construct a concrete floor over the entire area. Such a floor should have metal reinforcement to aid in preventing cracks. This may be of No. 6-gage, 6-in. by 6-in. electric-welded wire mesh. which should be 2 in. below the surface.

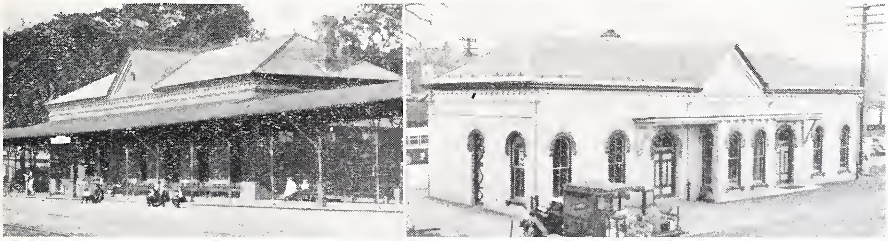
Improvements to side walls of frame stations can be accomplished in various ways. There is nothing wrong with good frame walls as originally constructed, with the possible exception of the trim that was used in former years. This trim can be replaced with more modern types at little expense. The siding material is usually in fair condition, but covered with layer upon layer of paint. These layers of paint must be removed before it will be possible to do a good paint job. In cases where it will be expensive to remove the paint, and the siding is in need of extensive repairs, it may be more economical to replace it all—possibly using a more desirable material.

Side Walls

Asbestos-cement material, either siding or shingles, can be applied to frame walls with success—assuming that proper precautions are taken, such as providing a concrete foundation beneath the structure, and brickwork facing to the height of the window sills. Before applying the new siding, a waterproof paper should be applied to the old siding, the new siding being nailed or screwed in place. Battens of the same material must be applied over all joints if asbestos cement sheets are used. All trimming is usually of wood.

Some years ago, stuccoing was the fad, and railroads did considerable of this kind of work. The usual practice was to nail a wire mesh to the wood siding and then apply the stucco. Some of these jobs were good, but many were bad. Cracks appeared, due probably to settlement of the foundations or to vibration from passing trains. Stucco can be damaged severely by the movements of baggage and express trucks on the platform side of a station, and by vehicular traffic on the street side. Proper concrete foundations are necessary for stucco jobs, and it would be best to provide brickwork from the platform level to the height of the window sills, with the stucco extending from that level to the eaves. Stucco applied to cement, haydite or cinder concrete blocks has lasting qualities. However, except for certain southern states, where climatic conditions are favorable, its use for railroad structures is not recommended. Probably the best of the improvements that can be made to frame side walls is brick veneer. However, this is rather expensive, and the usual type of frame structures will not warrant the necessary expenditure.

The side walls of many of the older brick stations were generally constructed of stone to the height of the window sills, with pressed brick above to the eaves. Such walls become quite dark and grimy over a period of years, and get very little attention, if any, in the way of cleaning. Any project for improving the appearance of such stations should take into consideration tuck pointing and cleaning. The cleaning of stone and brick walls can be ac-



The Passenger Station of the New York Central at Hudson, N. Y., Before and After Recent Modernization

complished readily by steaming, and at a reasonable cost. Sandblasting of stonework might be resorted to, but it tends to injure the texture of the stone facing. On brick work, a satisfactory job can also be obtained by washing it with the proper solution of muriatic acid, or other chemical, and then rinsing with clear water.

Doors and Windows

The windows and exterior doors of any station under consideration for improvements should be removed and replaced with those of modern design. Many of the doors in the older stations are more than seven feet high, with panels and trim of an antique design, and hardware of the same period. The windows are of similar construction, and, in most cases, are well worn and loose. It is essential that all such millwork be replaced. All windows should be weather-stripped; double-hung windows are preferable to the casement types. Windows, with the upper sash divided and the lower sash providing for a single pane of glass, have a neat appearance. In some cases, horizontal muntins may be used to carry out certain architectural features, or glass blocks may be used effectively in certain designs.

Roofs, Dormers, Gables, Eaves

In the older types of structures, one finds many peculiar innovations that are intended to draw attention to the roof structure. These include massive towers, or steeples, supporting clocks or weather-vanes; small iron fences along the ridge lines; dormers of various shapes; gables, with an abundance of carved wood designs and latticework, also, wide overhanging eaves. Probably no consideration was given to future maintenance of these appendages, and, in most cases, no maintenance was given. In general, much of this ornamentation should be removed, thus materially improving the appearance of the structures.

Floors

Most of the older passenger stations were provided with wood floors throughout, which, in time, become badly worn. Probably the most satisfactory improvement that can be made to such floors is to cover them with asphalt or rubber tiles. Such tiles are manufactured in various sizes and in a multitude of colors. The size of tiles should be determined by the size of the room involved, using small tiles, say 6-in. by 6-in., in a small room, and larger tiles, say 9-in. by 9-in. or 12-in. by 12-in., in a large room. A border strip can be arranged for, and, if desired, various figured designs can be laid inside of the border.

The proper color will vary with the location and with individual taste; however, the color should not be too light. A pleasing effect can be obtained with red and black tiles, laid alternately; or, mottled colored tiles of various shades of brown and green. A molded rubber base, about 4 in. high, with cove at the floor line, may be provided along all walls, and particularly in the toilet rooms.

In laying such tile floors, certain advance preparations must be made to secure a satisfactory job. If the floor is badly worn, it may be necessary to fill low spots with a mastic, after which, a thin sheet of asbestos-cement or plywood should be nailed to the floor to provide a perfectly smooth surface. A layer of felt paper is glued to the surface thus prepared, and on this the tiles are laid in a specially prepared mastic, and then rolled. For this type of floor covering, it is essential that the floor be of sufficient strength and firmness to prevent springing or weaving under traffic.

Existing wood floors, when badly worn, can also be improved by laying another wood floor over them. The new flooring may be hard maple, edge-grained fir, or yellow pine, and can be laid at reasonable expense.

In some instances, it may be best to remove the old wood floor system entirely, backfilling with sand, gravel or cinders and constructing a new concrete floor. Such floors are hard, and appear cold in natural cement finish, but they can be colored with mineral pigments and laid in tile designs to enhance their appearance.

It is highly desirable to install tile or mastic floors in toilet rooms, as wood floors are hard to keep clean and soon become a nuisance. Such floors can be laid over wood construction by sheathing between the joists, filling in with concrete with light mesh reinforcing, and laying the surfacing material on this construction. This construction may result in a small change in elevation as compared with the adjacent floor, but this can be taken up with a sloping threshold.

Walls and Ceilings

The walls and ceilings in some of the older stations are covered with dressed, matched and beaded lumber; the casings about doors and windows are of an ornamental design; they have wood baseboards, wainscots, caps and picture molds; and the ceilings are generally from 12 to 16 ft. high. An examination of such walls and ceilings will show shrinkage cracks, loose boards and warping. To paint such surfaces does not help their appearance much.

Within recent years, a number of new types of wall and ceiling coverings have come into the market, and, as a result, a designing architect now has an opportunity to use his talents along decorative lines. Some of the more popular types of new wall coverings are pressed woods, cane fibre boards, and boards composed of cement and asbestos fibres. The last named material can be obtained in a number of different colors, such as light green, buff, rose, grey and black. The other materials can also be obtained in various shades and designs.

For ceiling material, scored wood, or cane fibre insulating board can be obtained readily. This material comes with ship-lap or tongue and groove joints, and one-half, three-quarters and one inch thick—the half-inch material being used generally for ceiling application. Various sizes of panels, or scoring, can be obtained and laid up in interesting patterns. The material should be backed with a ply of heavy waterproof paper to prevent "breathing," or the passage of moisture-laden air, which quickly stains the finish. It can be painted, if desired.

When applying the asbestos boards, hard pressed-woods or cane fibre boards to walls, all wood trim about doors and windows, wainscot cap, baseboards and other trim, must be removed to provide a smooth working surface. It is best then to apply a layer of felt paper, tacking it to the wall. The covering material is applied and held in place with aluminum or other types of moldings. These moldings are of various shapes for vertical and horizontal joints, inside and outside corners, and caps. All wood trim in redecorated areas should be of the modern narrow types.

Unusually high ceilings are not an uncommon feature in older stations and it is often desirable to fur them down to obtain better room proportions. In some cases, the area thus afforded above the new ceiling can be used effectively for housing the ducts from modern unit heaters and evaporative-type coolers.

There are several so-called interior stuccos on the market that can be applied in interesting textures, and, being self-colored, require no painting. Furthermore, this material can be cleaned and will require no painting for a considerable period of time. Interior colors of medium light to light shades are preferable to the darker shades, because of their aid to improved lighting and the added atmosphere of cheerfulness which they give to the surroundings.

Ticket Office

In stations where two waiting rooms are in use and the ticket office is mid-way between them, there is very little that can be done to improve the general appearance unless the office enclosure is entirely removed. A railroad in the middle west removed such an enclosure in one of its stations and replaced it with an open ticket counter. Where it is possible to dispense with one of the waiting rooms, or to make one general waiting room, the ticket office can be constructed across one end of the area, providing a pleasing appearance.

In any ticket office, it would seem that the ticket windows could be made more attractive by removing the grille work and substituting a glass panel, with an opening at the counter level and another opening for a "speak-hole." A variation of this would be horizontal strips of glass, about two inches wide, set about an inch apart.

As for the interior of the office, the old-fashioned ticket cases should be replaced with modern back counters fitted with drawers for tickets and cash. File cases, pigeon holes and various drawers should be provided beneath the ticket window counter, so that nothing in the office shows above the counter level.

Furniture plays an important part in modernization schemes. Well-designed wood settees have a neat appearance and can be made comfortable. Such furniture is substantial and cannot be damaged easily. However, the trend is toward chairs and lounges with chromium-plated tubular steel frames and bright-colored leather or fabric upholstery. Such furniture is subject to malicious damage and should not be installed except where policing is constant.

Telephone booths, luggage lockers and various vending machines can be made to fit in with modernization work; some of these facilities can be built into partition walls.

Electric Lighting

Electric lighting was installed in many of the older stations some time after the original construction. In many cases, conduits and outlet boxes were left exposed, and drop cords were provided with ordinary reflectors over the lights. In such cases, practically all conduits, wiring and lighting fixtures should be removed and replaced. Lighting fixtures are an important part of modernization, and regardless of how much a room is refurnished, old style or ordinary commercial lighting units will nullify the appearance. Modern fixtures, or specially designed units suitable to the room treatment, should be used. Very effective decorative schemes can be designed with the use of fluorescent lights; such lights have become quite popular. Ample illumination should be provided, erring to over, rather than under lighting.

Decoration

Decoration is a vital factor in the appearance of a building, both interior and exterior, and appearance is very important in station buildings, where the public interest is paramount. The present trend is toward colors—even bright colors. Most of the materials now available for inside walls, ceilings and floor coverings are colored, and a variety of selections can be made. Present practice is for a comparatively dark wainscot, lighter wall coloring to the ceiling level, and still lighter ceilings. It is best to select a floor covering of the darker shades, or of mottled browns and greens.

As for outside decoration, or painting, most railroads have standard colors for frame buildings. However, if any appreciable degree of success is to be obtained in modernization work, there must be a deviation from such standards. It is believed that the reaction of patrons to a break in the monotony of standard colors will be quite favorable. The standard paint colors of individual roads should not influence the color scheme. In fact, some roads with streamlined passenger equipment are decorating their stations to harmonize with the color schemes of their modern trains.

Heating Facilities

Most stations, where modernization might be contemplated, are already equipped with an adequate heating plant. If the piping of such a plant is exposed, consideration should be given to placing it out of sight—preferably on the basement ceiling if there is a basement or space for such pipes under the floor; otherwise, by providing a trench in the floor. Pipes that lay along the baseboard are unsightly and provide space for the accumulation of dirt; overhead pipes do not have this disadvantage, but are not much better in appearance.

Radiators are nearly always placed at the windows, and, for that reason, must be low and long. They are placed in this location because the infiltration of air is greatest at the windows. Where space occupied by radiators is an important factor, recessed types may be used. Metal covers on radiators improve appearances.

The use of unit heaters in passenger stations might be considered. Many waiting rooms are very high, and unit heaters drive the heated air from the ceiling areas towards the floor level. Furthermore, circulation of the air will be much improved.

Toilet Facilities

Probably there is nothing at a passenger station that is talked about more than the toilet facilities. Health authorities are continually advocating better and more modern facilities, and their proper maintenance. Other forms of transportation have given special attention to such facilities, which has brought favorable comment repeatedly from the traveling public.

The entrances to the toilet rooms for men and women should be at least 20 ft. apart; they should be neatly labeled, and so located as to be not too conspicuous. The floors of the rooms should be of an impervious material, such as cement, or various types of tiles, with a cove base of similar materials. All walls and ceilings must be of plaster or some other non-absorbent material. It is preferable to omit any woodwork, and, with that in mind, all toilet stalls should be of metal or other impervious material.

It has been the custom for many years to install toilets with high tanks, pull-chain flushing device, and full rimmed seats with hinged covers. The present-day practice is for low tanks and open-front seats with no covers. Flush valves, in place of tanks, are preferable. With flush valves, the proper size supply pipe must be used.

Urinals should be of the floor type, with an automatic flushing device, and should be placed on 24-in. centers. This type obviates the necessity of floor drains, which should otherwise be placed in toilet rooms for use when washing the floors. Pedestal-type urinals are used on some railroads and have proved quite satisfactory.

One or more lavatories should be placed in each room with chromium-plated fixtures. As hot water is seldom available at outlying stations, it is customary to install a cold water faucet only. A neat mirror may be installed in each room at slight expense, which adds to the appearance of the room and the comfort of patrons.

Some roads have installed colored fixtures. These can be obtained in various colors such as maroon, green, yellow and black. When installing colored fixtures, care should be taken to redecorate the walls, ceilings and floors to harmonize with them.

Drinking fountains should never be placed in toilet rooms. Obviously, they should be placed in close proximity to such rooms in order to take advantage of shorter waste, vent and supply piping. The bubbler-type of fountain should be discouraged; in fact, many states prohibit its use. The angle stream type is recommended.

The original platforms built at small stations were nearly always of wood, or, for more important stations, of brick. Wood platforms are a source of continual maintenance and should be considered for replacement with permanent types when improvements are contemplated. Brick platforms were very popular until the advent of concrete, or cement platforms. They have the advantage of easy maintenance and present a good appearance. Concrete platforms are good, but must be placed on firm foundation material to avoid settlement and consequent cracking and disintegration.

At the larger stations, platform shelters are essential and cannot be dispensed with entirely. However, there are many locations where such facilities are no longer needed and can be removed, thus saving maintenance expense and adding to the appearance of the station building. In other cases, a large portion of the shelter can be removed without disadvantage.

The wide overhanging eaves on most of the older stations present a problem for any one attempting to improve the outside appearance of such a building. In some improvement jobs, such eaves have been removed entirely; in others, only partly. These wide eaves not only present a poor appearance, but exclude daylight from the interior, resulting in dark, dismal rooms. Any alterations to the roof structure should also include consideration of the alteration of overhanging eaves.

Today, parking space for automobiles is very essential, not only at suburban stations, but also at outlying stations as well. Such parking areas and driveway approaches to the station should be improved with cinders or chats, where available.

It is obvious that the modernization of each station presents a separate and distinct problem, and that it should be considered as such. Much of the work to be done rests with the individual in charge of preparing the plans, subject, of course, to the approval of his superior officers.

This report should be considered as a series of suggestions, or possibly as a guide, as to what might be done to modernize an old passenger station. It is evident that improvements should be made to some of the more important passenger stations to keep abreast of the times.

DISCUSSION

President Church: We are pleased to have with us this morning, representatives of the Building committee of the American Railway Engineering Association, who have joined with us to hear this report. It has been a most excellent report, and we are now ready for any discussion of it.

Armstrong Chinn (Alton): It would be about as difficult for me to add anything to this very comprehensive report as it would be for me to try to add words to an unabridged dictionary. I think this report could be used as a Handbook of what to do to modernize stations. The need for modernizing some of our stations is apparent to all of us. During the last six or seven years, we have given much attention to modernizing our trains, and now have trains that are beautiful in every respect. But, unfortunately, people often have to get on these trains from a dingy, unattractive station, and I wonder what they think about it.

Suppose the lobby of this hotel, which is otherwise modern in every respect, was as dingy as some of our passenger stations. I wonder how many of you would want to stay here.

Suggests Lowering Ceilings

I think that the competitive angle has to be considered. As pointed out in the beginning of the report, we have to compete for passenger business with the airlines, and every airline station that I have been in is very attractive and modern. We should have stations which meet that competition.

There are several other items in this report that we might comment on—in fact, a lot of them. I have several stations with very high ceilings, and one of the difficulties we have in such stations is that of heating them. All the heat goes up to the high ceiling and the cold air lies along the floor with the patrons. I think we could save fuel as well as give our patrons more comfort if we lowered those ceilings and brought the heat nearer to the floor where it is needed.

I was quite interested in what was said about toilet facilities. No doubt many of you, like I, have gone in toilets which smell more like a fox's den than like modern toilets. I know that is offensive to our patrons, and we should do something about it.

I can't add anything further to the report. My only suggestion is that everyone who has this problem read it over carefully before they do any work. There is a lot of valuable information in it.

Radiant Heating

L. P. Kimball (B. & O.): Along the line of one of Mr. Chinn's remarks, I would like to ask the committee if it considered the possibilities of radiant heating of station waiting rooms?

Chairman Winkelhaus: No, we did not. You mean by placing the heating pipes in the concrete floor?

Mr. Kimball: Yes.

Chairman Winkelhaus: No, the committee did not consider that at all. I know of no station that has it, and I haven't been able to get any information on it. I have seen the exhibit in the other room and it seems to have possibilities, but I don't know who is going to be the first to put in one of those installations.

Mr. Kimball: I would like to know the results of such an installation when one has been made and has been given a good test.

Mr. Chinn: Mr. Kimball, do you know of any installations like that? I had never heard of it before.

Mr. Kimball: Not in a railroad building. I have been considering it myself rather seriously but I haven't had the nerve to try it out.

Mr. Chinn: That is radiant heating with steam?

Mr. Kimball: It is hot water, Mr. Chinn.

Mr. Chinn: I believe radiant heating has been tried with electricity in some places, though not in railroad stations. I wonder if you know anything about that?

Example of Radiant Heating

K. L. Miner (N. Y. C.): I might answer the question as to where you can find out about radiant heating. A prominent manufacturer of wrought iron pipe has sent out a number of pamphlets and will give you information as to where it has been installed and what it will do. I, like the other two gentlemen here, would like to look over one of these installations, because, theoretically, it is a fine proposition. The heat comes from the bottom and you get it all the way up through the room. And the piping does not interfere in any way with the full use of the room.

I know of a passenger subway which is without heat, and, because of this, there is considerable condensation on the floor and on the walls due to temperature changes. With radiant heat in its concrete floor, that subway could be made much more comfortable; sweating would be avoided, and the heating system would take up no room at all.

Mr. Chinn: Mr. Miner, how do you prevent loss of heat downward? I suppose there is a tendency for the heat to go down as well as to come up.

Mr. Miner: I must recommend that you contact the company that is promoting this type of heating. I presume that asbestos insulation is placed at the bottom of the pipe installation. Besides, heat has a natural tendency to flow upwards.

President Church: The discussion on this report has been very interesting. Is there anything further? If not, we will dismiss the committee with the thanks of the association for its excellent report.

Railway Buildings In a Changing Age

By A. O. Lagerstrom

Architect
Chicago, Milwaukee, St. Paul & Pacific, Chicago

(Introduced by President Church)

President Church: One of the first railways of the country to introduce streamlined passenger service was the Milwaukee, with its Hiawatha operating between Chicago and St. Paul, Minn. This train has made an outstanding record, the momentum of which has increased with the years. In still another direction, this railroad has been similarly progressive, for it was one of the first to recognize the possibility of gaining public favor through the modernization of its passenger station facilities. At Minneapolis, at Milwaukee, at Madison and at other important points on its system, it has overhauled its passenger stations and has made them structures of civic pride. This work has been done under the direction of A. O. Lagerstrom, architect of the road, who will give us the benefit of his experience and observations in an address on "Railway Buildings in a Changing Age."

Address

Every modern going concern which sells to consumers, even including such bulwarks of conservatism as banks, knows, that to present itself to the public favorably, it must be attractive. We, as the designers of railroad structures, must fall in line with modern functional design. I emphasize the word functional, because many new and successful materials are available to us now, and their use should lead us into more modern, more practical and less wasteful design than we have practiced in the past.

For many years we have been building and designing heavy, enduring structures, and we may well be proud of them, because they have stood the test of time and have been able to take care of increased traffic. Today, to a large extent, we can reduce weight and build just as strongly.

Recent developments in methods have brought to light uses and advantages in our usual structural materials that we never suspected as recently as five years ago. Today, modern design has given these old materials a new lease on life, and we must be able to incorporate them in our conception, along with new materials. Not only this, but today we have learned, unfortunately the hard way, that through the application of modern design and materials, we can fit our buildings in with local settings. Of course, discretion must be used in this regard. Too often in the past, to the detriment of the communities in which we have tried to instill a pride in their railroad facilities, we have designed without regard for their local backgrounds. This policy did not invite revenue or respect from patrons.

Builders' Dreams Come True

Today, as the result of scientific research and the development of new tools and materials, the dreams of building men have largely come true. Are we taking advantage of these developments? Are we using them as efficiently as other modern industries are? Unfortunately, it has been much easier to get our competitors, the air and bus lines, interested in merchandising through appeal in their structures and facilities, than it has been to interest railway officers, who have lived with their structures so long. It is really remarkable how we have been able to compete with our competitors as well as we have, in the face of their new facilities, incorporating the last word in appeal and service.

We building men on the railways know all the requisites of our jobs. We are specialists and so are our superior officers. We do not need the assistance of outside specialists for many of our detailed design problems, but it is true that such specialists, with a general "birdseye view" of all transportation requisites, can be of great help in aiding railway managements in visualizing the importance of modern architecture in their more important stations, and the part that their building departments must play in this regard if we want to "Keep up with the Jones's."

President Church: Thank you, Mr. Lagerstrom for the fine contribution relative to the modernization of passenger stations that you have brought to us. Since it is now getting late, it will probably be well for us to adjourn.

In the Milwaukee's Station at Milwaukee, Wis., After Modernization

Protection of Railway Structures Against Sabotage

By E. P. Coffey
Chief of Technical Laboratory
Federal Bureau of Investigation
Washington, D. C.

(Introduced by President Church)

E. P. Coffey

President Church: We on the railways recognize that railway service is essential to national well-being in any day. In times of war, continuity of railway service is vital. The guarding of essential structures requires special precautions. Many of these precautions are self-evident. Others, possibly equally essential, appear so commonplace as to be overlooked. It is here that the advice of men trained to consider all possibilities becomes of special value. One of the newer agencies of our government is the Federal Bureau of Investigation, commonly known as the F.B.I. Dramatized by the dynamic personality of its leader, J. Edgar Hoover, with its 53 agencies and 2500 members operating in the United States and its possessions, this organization is rendering a service, the full importance of which cannot be told. Mr. Hoover and the members of his organization share with railway officers concern over the maintenance of uninterrupted railway service. Mr. Hoover would have liked to have come before us in person but was prevented by other demands upon his time and he, therefore, arranged for Mr. E. P. Coffey, chief of the Bureau's technical laboratory, to come before us as his personal representative. Mr. Coffey will speak on "The Protection of Railway Structures Against Sabotage." Mr. Coffey.

Address by E. P. Coffey

Before I left Washington, Mr. Hoover asked me to be sure to give you his regrets that he could not be here. He wanted to come, because he feels that this organization is very important in connection with the work of the Federal Bureau of Investigation against sabotage and espionage in these emergency times. The fine co-operation of this organization in the past and the continuance of that co-operation in the future is very essential to the work of the F.B.I. He also asked me to take this opportunity to express to you his best wishes for a very successful meeting.

The Federal Bureau of Investigation, under the direction of J. Edgar Hoover, was charged by the President in September, 1939, with the co-ordination and handling of all matters pertaining to sabotage, espionage and similar matters concerning our internal defense. Shortly after that, the authorities of the army and navy requested Mr. Hoover to undertake to survey the manufacturing plants of the country engaged in defense contracts, with a view to making recommendations which would protect these plants against sabotage and other hazards which might be inimicable to the national defense program. This work has now been going on for two years, and more than 2,000 of these plants have been surveyed by special agents of the F.B.I. This program is a precautionary one and important, because it is felt that every effort made to prevent any interruption of the defense production program, no matter how slight, is very important.

Bridge Men Have Responsibility

You gentlemen are charged with an equally important task. It will be of little avail to produce and manufacture the defense needs of the nation if they cannot then be shipped successfully to the points of greatest utilization. The railroads of the nation constitute the great transportation system in our defense program. The protection of their bridges thus becomes one of the most important tasks in the present national emergency. Those who would destroy and interrupt our nation's defense program will endeavor cunningly to attack those points which are not only certain to disrupt things seriously, but which are of such a nature that their repair or replacement is most difficult. To block the right of way of a main trunk line, for instance, might stop transportation effectively on that line temporarily, but removal of the barricade would probably require only a short time and normal operations would soon be resumed.

When an important railroad bridge is attacked, however, it not only blocks current transportation effectively, but it becomes a major piece of engineering and reconstruction, requiring perhaps, many weeks, if not months, before repairs or replacement can be made. Bridges, by their very nature, are attractive to the saboteur, because, frequently, most complete destruction can be effected by a relatively small attack on a crucial part of the structure. I point these things out to you to emphasize the importance of your job, and to urge you to greater ingenuity and greater alertness in the protection of these strategic structures. The history of past wars is replete with reports of bridge destruction as a primary form of attack. Attempts at bridge destruction by saboteurs and fifth columnists may be expected. It is the job of you men to do all in your power to prevent this.

Many of you already have plans under way for the proper protection and maintenance of your bridge structures during this emergency. If you have not begun to plan this work, it should be started at once. You must not anticipate that the military authorities, the state or local police, or some home guard unit will protect your bridges. It is quite possible that in some instances, some of these governmental organizations will undertake the protection of a particular bridge for a particular reason. But it is upon your skill and experience as bridge maintenance men that the nation will have to depend to safeguard all other structures. Of course, the railroads will not stop with the protection of their bridges. Their right of way, docks, shop buildings, yards, roundhouses, terminals, and freight houses and warehouses are all important factors in the nation's transportation system, and for the very fact they are important, become objects of possible attack by the saboteur.

As the Need for Protection Grows, It Will Be Necessary to Guard Many Tunnels and Bridges, Particularly Those in the Most Vulnerable Places

Report Sabotage Promptly

As I have already indicated, the Federal Bureau of Investigation is charged with the responsibility of investigating sabotage and attempts at sabotage. It becomes important, therefore, that you see that the personnel under your supervision knows that the F.B.I. should be called promptly by telephone whenever any sabotage or attempt to sabotage occurs, no matter how small. It is important that the F.B.I. be called promptly so that its special agent may reach the scene of the crime early enough to make a detailed study for any clues which will lead to the identity of the saboteur. It is important even though the attempt seems a minor one, because it may actually be found by agents of the bureau to be connected with a major operation of sabotage being carried out over the entire country.

The agents of the F.B.I., especially trained in the investigation of sabotage, may be able to recognize the method of operation from previous cases in which a like attack was made. When they prepare their detailed reports of their investigation at the scene of an accident or seeming accident, the reports are forwarded promptly to Washington, where specialists in the detection of sabotage review them closely and co-ordinate them with other similar cases from perhaps entirely different parts of the country. This system, providing in a sense a clearing house for information, permits the F.B.I. to maintain a bird's-eye view of the situation over the entire nation at one time. Waves of sabotage may thus be recognized quickly and the necessary action taken.

F.B.I. Has Trained Investigators

The F.B.I. maintains a technical laboratory at Washington, staffed with more than 65 scientific men and 45 cryptographic employees, whose job it is to make a scientific study of the physical evidence found at the scene of the crime. In cases of sabotage, this evidence is frequently of the utmost importance, and its scientific analysis is sometimes the most important, if not the sole clue to the criminal. For instance, experts are specially trained in the analysis of lubricating oils which have been diluted or contaminated by the saboteurs in an effort to destroy important machinery. The destructive element is reduced and identified, and in this manner can frequently be traced by the field investigators to its source, which sometimes leads to the saboteur.

Abrasives, such as ground glass, emery dust or steel filings, are sometimes thrown into important bearings, and there accomplish destruction. These tiny bits of material are examined microscopically, and sometimes chemically and spectrographically, in the laboratory, and their nature determined. Subsequently, when investigating agents produce sample materials from suspected sources, these are likewise analyzed and compared as to kind, quality and size with the material used to do the damage.

Experts in soil analysis examine mud removed from the tires or fenders of automobiles suspected of having been driven to a point where sabotage was committed, and compare this with the soil at the scene of the crime. Other experts study tool marks left in metals during sabotage attempts. Sometimes the screw driver or hammer used to gouge into finely made bushings or other precision parts can be identified definitely as the tool which made the particular mark.

Streamliner Wreck Studied

A year and a half ago an important sabotage case was studied in the bureau's laboratory, in which practically all of our scientific procedures were utilized in reaching certain final conclusions. In this case, a transcontinental streamlined train was wrecked. A rail had become moved at the approach to a bridge over a stream and canyon. This happened in such a manner that the train would be thrown against the bridge and into the canyon. Part of the train escaped across the bridge, but several of the cars fell down the embankment.

The statement of the engineer in this case suggested sabotage, but the rails had been torn up by the wreck and there seemed to be little evidence to offset a staunch suggestion that carelessness on the part of the company caused the wreck. Laboratory experts of the F.B.I. examined the scene, and subsequently studied much of the evidence in Washington. The rail displaced, for more than half its length, had been painted on its running surface with a dark brown paint. Was this done by the saboteur, supposedly, to kill the reflected gleam from the headlight of the train, upon which the engineer would depend to assure him that the track ahead was clear? Ugly rumor suggested that this rail had been painted after the wreck.

The Diesel engines of the train had negotiated the bridge successfully, although they were off the track. Scrapings were noted on the painted rail. The experts proceeded several hundred yards from the point of derailment to where the Diesel engines rested. Climbing beneath them, they scrutinized every bit of the undercarriage, and there found small scrapings of the dark brown material. This was analyzed spectrographically and was found to be paint—paint of the same color and composition as the paint used to disguise the rail several hundred yards back. This established positively that the rail had been painted at the time the Diesel engines left the track. Other laboratory analyses identified the manufacturer and particular brand of paint, and, subsequently, a small paint can was found discarded near the wreck.

In dragging the creek above the point where the wreck occurred, a bundle of track tools was found tied up in two zipper leather jackets. Included among these were claw bars and track wrenches. Toolmark experts of the F.B.I., using precision comparison microscopes, were able to prove that these were the tools used to remove the spikes and bolts in shifting the rail. The criminals responsible for this sabotage have not yet been located. At the time the wreck occurred there was no Federal law which would cover such an offense, and the Bureau's efforts in this case were limited necessarily to making its laboratory facilities

Bridges with Drawspans Require Special Attention. Drawspans May Be Jammed So They Cannot Be Lowered, or the Mechanism May Be Tampered With in Such Manner That the Draw Operates Wrongly at the Approach of a Train

available to the railroad police and the local law enforcement authorities.

Laws Against Sabotage

On June 8, 1940, the President approved a law which makes it a Federal crime to wreck or attempt to wreck a train engaged in interstate commerce. This law covers any willful and unlawful attempt at such wrecking, and refers specifically to the firing or exploding of tunnels, bridges, viaducts and trestles. This is the principal peacetime statute which gives the F.B.I. investigative jurisdiction over attacks on your bridges. Another peace-time statute which, in some instances, might have effect, is that which covers violent interference with foreign commerce, and makes it unlawful to obstruct in any way the exportation to foreign countries of articles from the United States. In time of war, the Federal statutes dealing with sabotage are more embracive and provide more severe penalties. It is because of these laws that it is so important for you to report promptly to the nearest office of the Federal Bureau of Investigation, any attempts at sabotage which come to your attention in the performance of your duties of maintaining and protecting the railroad bridges of the United States.

Study Weaknesses

Planning the protection of your bridges against sabotage is a big job that requires careful planning. This planning should begin with detailed surveys, in which you men, as experts on bridges, will study the vulnerability and weaknesses of your structures from the standpoint of sabotage. This study should include the approaches along the right of way, a determination of the best manner in which the bridge can be guarded or patrolled. Consideration of the possibilities of attack from below is very important. Not only may supporting piers be fired or exploded, or cut by hand, but where rivers or streams are concerned, consideration must be given to the possibility of floating explosive or crushing devices against the piers, released from a point higher up the stream. A serious threat is that in which the bridge is wrecked or blocked by causing a heavily laden train to be wrecked as it crosses. Drawbridges require special attention to protect their operating mechanisms. These may be jammed so that the draw cannot be lowered or the mechanism may be tampered with in such manner that the draw operates wrongly at the approach of a train. Where these are operated electrically, special attention must be given to the protection of the source of electric power and to the transmission lines to the bridge.

Study should be made to determine the weaknesses of your bridge structures, and plans made to strengthen them. Sabotage is frequently made to appear as an accident. Thus, advantage may be taken by the saboteur of existing structural defects or natural fire hazards on the bridge, such as where wood ties are exposed or wood underpinning is not made fireproof. Other seeming accidents may result from landslides on the bridge or on its approaches. All of these hazards should be given prompt study and plans for meeting them worked out.

As the need for protection grows, it will be necessary to guard many bridges, particularly those carrying the most important traffic and those in the most vulnerable places. These, possibly, will include the international boundary bridges and the huge bridges connecting key points, where a serious bottleneck is sure to result if any of them is rendered useless. In guarding these bridges, consideration should be given to the desirability of fencing approaches, and, in some instances, carrying this fencing at least partly into the water so that the legitimate openings through which trespassers might enter can be watched more easily. Proper lighting should be given study. At times, this is most effective in detecting trespassers, and is just as important in acting as a deterrent to frighten them away. Answers to questions concerning the number of guards, the hours when they will work, their method of standing guard at approaches or patrolling the bridge itself, as well as to all other local questions, will depend entirely upon the specific point and situation to be guarded. Your experience during the last war should be most important to you in planning safeguards during the present emergency.

Planning Not Enough

The planning and installation of safeguards and patrol systems are not enough. They must be rigidly maintained and strictly enforced. It is a natural human tendency to drop our guard after the first day or two of initial excitement with a new job. This is the great danger with guards and protective systems. So it becomes a maintenance job—a job not only of maintaining the physical safeguards, equipment and system itself, but of maintaining a sharp alertness and enthusiasm in the personnel upon whose shoulders rests the actual job of guarding structures. Frequent checks and inspections become necessary. The same alertness and enthusiasm that you expect in your men must be ever evident in yourself, or you will fail to inspire them.

These are some of the highlights of the problem. The details must be worked out locally and co-ordinated with your own railroad and maintenance problems. You may be certain at all times of the desire of Mr. Hoover to assist you in these problems. He is deeply appreciative of the co-operation that the F.B.I. has always had from the railroad police of the country. He is certain that you men, as engineers and supervisory officers, will work out successfully the problem of protecting railroad structures. And, if sabotage occurs, you may be equally certain of a vigorous, far-reaching and detailed investigation on the part of the Federal Bureau of Investigation to bring to light these nefarious criminals who attack the defenses of our nation.

President Church: Mr. Coffey, I thank you on behalf of all present for your timely and instructive message. We will all take home with us the points emphasized in your address.

We will now adjourn to the regular meeting room.

Effect of the Defense Program on the Procurement of Railroad Materials

By C. E. Smith

Vice-President, New York, New Haven & Hartford

(Introduced by President Church)

C. E. Smith

President Church: Are we going to get the materials we want? Are we going to be able to get them when we want them? To what extent are we going to find it necessary to substitute less desirable materials for those which we have long used? Of what value to us are priorities? How can we use them? These are some of the questions that confront every supervisory railway officer facing enlarged construction and maintenance programs. It happens that we have among our members a man who is eminently qualified to discuss these questions. He is the vice-president and chief purchasing officer of one of our largest and most active railways. Before that he was bridge engineer of another large railway and in that capacity was active in the work of our association, serving as our president in 1916-17. He is, therefore, one of us. He knows our problems. He speaks our language. He will tell us of the effect of the defense program on the procurement of materials—Mr. Chas. E. Smith.

Address by C. E. Smith

I consider it an honor to be invited to address this convention—quite as much an honor as my election as president of this association at its convention in New Orleans just 25 years ago. I deeply appreciate both of these honors. It is a pleasure to congratulate the association on this, its fiftieth anniversary.

When President Roosevelt coined the phrase "All Out" aid to Great Britain, he meant just that. It is becoming more certain all the time that he meant definitely that "All" materials and equipment that will be helpful to the British in winning their war, that can possibly be gotten out of this country, will be gotten "Out," regardless of its effect upon any of our own needs, except defense and most essential civilian requirements. This same philosophy is being applied to the wants of the Chinese, and also to the wants of the Russians, to the extent that they can be furnished from this country, to aid them in defeating the Central Powers.

It has been difficult for many to realize that this calls for individual sacrifices, and that it means "them" as well as their neighbors; that it includes those who are not in accord with this national policy, as well as those who are enthusiastic about it. If you do not like this policy, it is your privilege to say so, as we enjoy the right of free speech; but whether you like it or not, whether you agree with it or not, it is the duty of every American to get behind it as long as it is the announced policy of the Government.

Originally, wars were wars of men and little material. Animals depend on the tooth and the claw, and so possibly did early man until he learned how to use a club. But as men became more civilized, and as mechanical appliances were developed, more and more materials were used in combat in proportion to the number of men, until in the present war a new high point is being reached in the use of astronomical quantities of materials in proportion to the number of men involved.

The present emergency material supply situation differs considerably from that of the World War. Tanks, motor equipment, airplanes and anti-aircraft guns and munitions played a relatively unimportant part in the last war. British, French and allied armament production were not seriously interfered with by bombing from the air, nor by conquest of industrial territory. There was sufficient production for their armies and, to an extent, for our expeditionary forces. Our need was for ships to transport and convoy our men and supplies in the Atlantic only. Japan was on the side of the Allies, which relieved the United States and Great Britain of the duty of policing the Pacific. We were not called upon to arm other peoples.

In the present war, tanks, motor equipment, airplanes and anti-aircraft guns and munitions play an all-important part both in preparing equipment for our own Army and Navy and for aid to other nations, and the need for ships is at least as great as, and threatens to become greater than, during the last war. The Pacific as well as the Atlantic is involved. The European powers allied with Great Britain have lost much of their armament-producing capacity by bombing and conquest. For all these reasons, increased quantities of materials are required from the United States. We are arming other peoples in a large way.

This is a war of oil, metals and other materials, the use of which for military purposes is bound to have a heavy impact on industries not directly connected with defense production, particularly since the nation has changed suddenly from an economy of plenty and waste, to one of scarcity, selectivity and salvage. We are being called upon to reduce our use of materials for non-defense purposes wherever these materials are needed for defense.

With notable exceptions, there is enough material for all industries essential to defense production, such as mining, transportation, etc., and for other essential civilian requirements. But there is not enough of certain materials for defense, and also for the full, normal, non-essential civilian requirements of such items as mechanical refrigerators, automobiles, radios, toys, and thousands of things we have come to enjoy, depend upon, and take for granted. Many of these things we can get along without for a while, with the full assurance that they will be available again in full measure when the present emergency is over.

It will be difficult to deny ourselves many of the things we want and have the money to pay for, but do not need, although otherwise quite desirable. This applies to large things as well as to small things. The construction of large projects not essential to the defense program will have to be postponed, so that the materials they would require will be available for our defense program. The deferment of many such projects until after the present emergency is over will be beneficial not alone in avoiding interference with the defense program, but also to the extent that it will provide work and employment when industries will be relieved of defense requirement and will need other work to keep going.

The Railways Must Have Needed Materials of All Kinds for Current Maintenance and Essential Improvements to Meet the Needs of the National Defense Program.

Even though industries producing non-essential articles and non-essential construction projects be denied materials, there remains a difficult problem of distributing the remaining materials because demands are not evenly spread, and the demands for some materials for defense purposes alone exceed the supply. Silk and aluminum are notable examples. The solution is obvious—increase the supply as much as possible and allocate what is available in the order of importance. Even when there is plenty of any material, it is important that the defense needs be satisfied first, then the more essential industries, then the less essential, and lastly, the non essential industries.

Government Controls

Defense requirements and aid to "peoples resisting aggression" are now being given precedence over other needs. Civilian requirements are invited to "take a holiday." This has introduced new conditions into purchasing. Many materials needed critically for defense industries can not be secured for other use until urgent necessity and their effect on defense production are shown.

The public press is replete with information about the scarcity of materials. The shortage of silk, gasoline in certain areas, aluminum, steel and chemicals, and the potential shortage of rubber, are merely the beginning, as they and other materials are needed in increasing amounts for our defense program and for aid to Great Britain, China and Russia under our definite national policy to extend all possible aid to "peoples resisting aggression."

So far, defense production has inconvenienced only a small proportion of our population. Not very many have changed their mode of life or suffered personal privation. As government orders curtailing the use of one material after another take effect, their impact upon our lives may become a matter of concern. The action of the people with reference to the silk order is fresh in our minds, and the public reaction to the controversy over the predicted gasoline and fuel oil shortage on the Atlantic seaboard are examples of the confusion that results when the bitter war economy into which we are moving, with its attendant restrictions, comes in contact with our previous pleasant peace-time economy.

No one knows the extent of the government controls that will be necessary, but according to the present determination in Washington, they will be measured only by the greatest possible "All Out" effort in aid of our own defense and that of our friends overseas.

It may as well be understood that there is a grim and fixed determination in Washington to do this job—by willing cooperation if possible—but to do the job nevertheless, and that anyone who does not cooperate is going to be pushed out of line.

The heavy task suddenly thrown on Washington to deflect materials and production into our own military channels and to our friends overseas can be readily understood. It is becoming quite a task for private business to keep up with the various releases from Washington in the rapidly developing military picture, and to know how to secure materials vital to the operation of our railroads and other industries essential to the defense program.

For the purpose of directing the use of materials that are available so they will be most beneficial to the defense program, the Priority system has been devised. Priorities are exercised under authority vested in the President by Congress and delegated by him to the Office of Production Management.

Priorities Set-Up Explained

At the present time the priority situation is administered by the Supply Priorities Allocation Board, composed of the Vice-President, the Secretaries of the War and Navy, Messrs. Knudsen, Hillman, Henderson and Hopkins. Mr. Donold M. Nelson—recently executive vice-president of Sears-Roebuck—is executive director.

The men administering priorities are mostly well-known high business executives, furloughed by their companies and loaned to the government for full-time or part-time service. A roll call of their names would indicate a cross-section of American big business. They have brought to Washington many of their executive staffs. From personal contact, I can testify that the organization is as efficient as any emergency organization can be, and is being improved continuously.

The priority system, and the organization that administers it, are only a little more than one year old. It is marvelous that so much has been accomplished in such a short time. While it may appear to an outsider that there has been much confusion, there really is a definite pattern and a definite goal.

The O.P.M. has prepared a priorities critical list, which lists the principal items used by the military, as well as by civilians, on which army and navy representatives, in placing their orders or contracts, may issue preference rating certificates. It may also assign preference rating certificates on sub-contracts for these items. These certificates are being issued by army and navy officers at the rate of about 4,000 per day.

The list includes about 300 items, many of them of direct interest to railroad bridge and building men, such as barges, boilers, bulldozers, air compressors, cranes, power hammers, hoists, lockers, locomotives, machine tools, machinery, business machines, electric motors, nickel alloys, pumping equipment, rubber, scrapers, hand tools, welding rods and iron and steel products including rolled, drawn, forged and cast products, pig iron and Alloy Steel. The delivery of such items to the railroads can only be made when they are not needed for the army and navy, and for other defense requirements. Such items have been deflected to defense projects just before they were to have been delivered on long-standing railroad orders. In such cases, the railroads must wait for later delivery. Several items are so scarce in relation to the demand that they are subject to allocation. They include silk, aluminum and aluminum alloys, copper, machine tools, iron and steel, nickel, and products in which such materials are used.

It is under these controls that materials are being denied entirely to certain industries and individuals, and materially curtailed to others—such as the withdrawal of silk from civilian use, the cut in gasoline deliveries, the reduction of 50 per cent in automobile production, and the elimination of shiny gadgets that use scarce metals. It may be expected that as defense production and Lease-Lend aid overseas expand, the list of materials on the priority critical list and under allocation will lengthen.

It is not priorities that are causing shortages. Vast expansion in demands due to our huge defense program is causing the shortages, and it is this that is responsible for the need for priorities. We are not able to produce and import all the raw materials required to meet the needs of "All Out" defense, plus civilian demands—and more shortages may be expected.

No purchaser may secure a machine tool, nor may a manufacturer secure materials for building a machine tool until after the Office of Production Management, on proper application and showing of necessity, issues a priority rating for that particular tool. Other lines of production are being handled similarly or by blanket priorities.

Good Rating No Guarantee

Special orders of the O.P.M. of interest to railroad men cover the use of steel in all its forms, machine tools, car and locomotive materials, copper, rubber, zinc, repair materials and others. General Steel Preference Order M-21 put the distribution of steel under mandatory control, and places in the hands of the O.P.M. the control of the amount and kinds of steel that each industry may have. Meetings are held with representatives of steel producers monthly or oftener, at which schedules of shipments for ensuing months are decided upon. The demands of the army, navy, shipping, Great Britain and others for steel plates, rail and other products are provided for first, and then the railroads and other essential industries fall in line for their share of what is left.

Extensions and improvements are omitted specifically from blanket preference ratings which are issued to keep essential industries functioning efficiently. They are discouraged, except as needed to increase defense production. The only way in which certain materials can be secured for improvements is to make application to the O.P.M. for each specific project, supported by persuasive reasons as to why the improvement is vital to defense production.

Released Materials of All Kinds Must Be Given the Greatest Consideration

Many people think that it is only necessary to write to Washington to secure a priority rating. That is not so. These ratings are highly selective, and are issued only after careful study according to certain patterns, which give consideration to the relationship of the project to defense, the availability of the material, the importance of the industry, etc. Merely to secure a priority rating does not insure the delivery of material. That follows only when the company that has the order has the necessary material and does not have in hand orders with higher priority ratings. If it has such orders, then orders with lower ratings must wait, no matter how long they have been in.

If you are sometimes out of patience because you cannot get everything you want just when you want it, consider the automobile industry, which has been curtailed 50 per cent, and may be curtailed further, because the materials they ordinarily use cannot be spared. Industries that are denied materials are those that use materials badly needed for defense purposes.

Priorities are bound to hurt nondefense industries. In fact, they are meant to release needed materials for defense industries. We had better be philosophical about this, because until the current emergency is over, that is the way it is going to be. But necessary priority help will be and is being given to important civilian activities, including the railroads.

The mining industry was recently given a preference rating of A-8 to secure materials required for operation and maintenance, with the additional authority to use the highest rating, A-1-A, in emergency, the latter to be granted by an appropriate official of the O.P.M. on receipt of telegraphic or other request. The railroad industry and other essential industries, such as public utilities, need similar treatment. The treatment accorded to any industry depends to quite an extent on the representation of that industry at Washington.

How Fare the Railroads?

How fare the railroads in all of this activity? Railroading is not usually classed as a defense industry, but it would be difficult to designate one more important to the defense industry. Notwithstanding their importance, their needs for materials are not yet covered completely by priorities. They have not been granted any general preference rating for materials essential to their operations, normal maintenance or ordinary improvements.

Preference Rating Order P-8 entitles railroads and carbuilders so designated to use an A-3 rating for materials entering into the construction and repair of freight cars. Preference Rating Order P-21 entitles railroads and locomotive builders to use an A-3 rating for materials entering into the construction and repair of locomotives. Preference Rating Order P-22 entitles railroads and many other industries essential to defense and to civilian requirements to use an A-10 rating for materials for "repairs" to avoid "imminent breakdown," and for "emergency inventory."

You will note that this is quite severely restricted and does not cover supplies essential to operation, ordinary maintenance or any kind of improvements. I am advised that after long consideration in Washington, another priority is about to be issued which will give the railroads and many other industries an A-10 rating for all supplies necessary for operation and ordinary maintenance. But that introduces a further restriction in that it provides for the use of the priority only for replacements in kind, with no right whatever to use it for anything that is in any way different or better than that which it replaces.

For example, that priority could not be used to put in 112-lb. rail in place of 100-lb. rail. I believe, however, that those situations will be ironed out as time goes on.

Preference ratings are secured alone for individual orders for machine tools and other needs, and only after making application in each case on appropriate forms. Note that A-3 is the highest rating yet accorded the railroads. Defense requirements and certain requirements of other industries enjoy higher priorities. Companies having railroad orders and other orders with higher priorities may not fill the railroad orders until after the others have been filled.

Although the purchasing and stores departments of the railroads have been confronted with these new conditions for some time, along with suddenly increased traffic, calling for more materials than usual, no serious shortage of important materials has occurred as yet, except possibly in exceptional cases. There has been some delay in securing materials for new equipment, as a result of which the construction of new cars and locomotives is behind schedule, and it has been necessary to place orders much further ahead for materials than in the past in order to give suppliers an opportunity to work up to their shipment of these materials. In addition, there have been a number of shortages and many narrow escapes, especially in locomotive shops, and new rail deliveries are far behind on some roads.

Must Conserve Materials

Because of the priority situation, deliveries are most uncertain, and no one can foretell when certain types of equipment will be delivered. Recently, two Diesel switch engines were taken for a government project just as they were to have been delivered to a railroad. Deliveries to the railroad were set back to later dates. It is impossible to get reliable shipping dates for machine tools, locomotives and other equipment.

I might say that the situation is much as though you were playing poker and had three of a kind, a pretty good hand, and somebody comes along with a "full house" and you lose. Or you may have four of a kind and somebody pulls a "royal flush" on you. None of these manufacturers knows, no matter how high your priority or how important your order, when the mail is going to bring in one of these 4,000 orders a day being placed directly by the supply officers of the various munitions plants, that will take your material right out from under your nose. That is exactly what happened to the New Haven in the instance I cited. We had two Diesel-electric switch engines under construction for us by the General Electric Company. Just about one week before these engines were to have been shipped, the commanding or purchasing officer of the Burlington, Iowa, ordnance plant called up and said, "I am putting an order in the mail tonight for those engines, with an A-1-A priority." Ours was A-3. He took the trick. This situation should suggest to every railroad man, as never before, the necessity for care in the use of materials, and throws a new light on the necessity for reclamation.

Both from the standpoint of price, and because of the difficulty and delay in procuring many materials, it will often be prudent, and, indeed, sometimes necessary, to spend more money for repairing a usable tool or part than to wait for a new one. We must be more careful than ever before to reduce our use of new materials to a minimum, to avoid misuse and unnecessary wear and breakage, and to protect it from rust and decay. You will think of many ways in which the use of new material can be reduced.

The necessity for a preference order covering high-speed steel indicates that this material must be conserved. Worn tools should be repaired as long as possible, and when no longer usable, should be assembled at a central point, separate from other scrap, for its strategic value as well as its trade-in or exchange value.

Work Equipment

Work equipment is particularly difficult to secure because of the sudden commencement of many government projects on this continent and at our off-shore bases involving heavy construction, and it will be needed for reconstruction if bombing of these projects and civil works commences. So, maintain all your old work equipment. It may be with you a long time. It will be impossible to get any new work equipment so long as government contractors continue to buy it for government projects.

I have several cranes on order with the American Hoist & Derrick Company, placed last spring and scheduled for delivery in September. The delivery date has been extended and extended, and it is now predicted that we will get them, but not promised, by April, 1942. The reason for the extended delivery date on this order, which has an A-3 priority, is that the American Hoist & Derrick Company continues to get orders from contractors handling government projects in Iceland, Greenland, Bermuda and all over the world, as well as in the United States, for the same type of equipment; and they say they can't possibly put a date on the delivery of our order until they get rid of all of those prior orders. So we might just as well be philosophical about it—it is going to be that way.

Must Save Scrap

Up to a short time ago, manufacturers could and did refuse to take government orders in order to take care of their regular customers, but a general order has changed that, and from now on defense contracts come ahead of civilian contracts.

The defense requirements have directed attention to the importance of scrap in the manufacture of steel. During the depression, scrap accumulated beyond the ability of scrap dealers to hold it and beyond the desires of steel companies to buy it. As a result, brokers developed foreign markets which bought much scrap which is now badly needed here. Right now, not enough scrap is being produced to keep up with steel production and it is impossible to increase the supply by offering increased prices because the top prices have been set by the Government agency OPACS. Therefore, it is incumbent upon every one of us to see that every piece of scrap is picked up, and that it moves promptly to the steel mills and foundries.

In years of expanding railroad trackage there is always a big demand for relaying rail. In years of dwindling mileage, there is substantially no demand, as during the recent depression when the railroads took up much surplus trackage. Rerolling mills which had a regular cheap supply of used rail during the depression, because there was no other than a scrap market for a good deal of rail that would otherwise have been classified as relaying rail, are now up against it, because the railroads are not taking up so much trackage. On the other hand, government projects, industries, shipyards, and railroads' own requirements are making use of rail that has heretofore gone to the rerolling mills. This is further accentuated by delay in receipt of new rail by the railroads. Scrap should be gone over more carefully to detect usable material, and reclamation should be resorted to to a greater extent than ever.

Railroads Vital to Defense

It is important that we keep in mind the part each of us is to play. Aside from our duties as citizens, our first task as railroad men is to secure the things necessary to keep our railroads operating efficiently. We must co-operate with those governmental agencies that have the task of allocating materials where they will do the most good, but we must keep our railroads operating efficiently. This is going to require all the ingenuity for which railroad men are noted.

It may be assumed that traffic has not yet reached its maximum. It has been predicted freely for some time that the railroads were in no position to handle the defense traffic and would break down. Fears were expressed for the movement of the 1941 grain crop. That was moved without a hitch and is now history. Fears were expressed that the peak of fall traffic would floor us. Yet, here we are at the time of the usual fall peak and no signs of breakdown are apparent. On the other hand, with so few exceptions that they can be ignored as of no consequence—none have come to my attention—traffic is flowing freely, although the railroads are handling more than 900,000 loaded cars per week. When still greater traffic is offered, the railroads will handle it, but they must have materials to keep them in a high state of efficiency.

As to the importance of the railways to national defense, listen to the following extracts from the address of Chairman C. F. Lea of the Interstate and Foreign Commerce Committee of the House of Representatives, on Thursday, September 25, 1941, when he discussed "Transportation and Our Present Emergency."

"It is a modernized transportation system that faces the carrier problems of 1941. With these new investments, our transportation system is, unquestionably, the best the world has produced. Today, we have a railroad management that was schooled in our transportation difficulties in the World war, and trained in efficiency under the pressure of unfavorable economic conditions and the keen competition of the last two decades. In all the world, no job is being better done today than by the American railroads.

"It must not be forgotten that the transportation system of the country is the connecting link between production, distribution, manufacture and use. It is the basic activity on which other defense successes must rest. It would seem that every effort possible should be made to supply that deficiency in its materials for which priorities have not been granted. There will always be an opportunity to improve the service by the use of equipment in existence, but transportation cannot be increased with any degree of efficiency by equipment ordered but not in use."

Quotes Mr. Pelley

Listen also to the following extract from a statement to the Senate committee, October 2, 1941, of J. J. Pelley, president of the Association of American Railroads:

"The record of the railroad industry since the present emergency arose two years ago is one that justifies confidence in our statements as to what we can do. We handled all the business offered in 1939, as we said we would do. We did the job again in 1940. We will do it again this year, and if we can get the material we need for the construction and maintenance of cars, locomotives and other facilities, we will do it next year. I can assure the committee of the desire and determination of the railroads to cooperate in every way with shippers and with departments of the government in furnishing the rail transportation which is so vitally necessary to our national defense. Our performance is known and appreciated by shippers and by Government officials generally, especially by those who are in a position to know something about it."

I want to quote also the following extracts from items that appeared in the New York Times, October 8, 1941, indicating the military importance of railroads:

"The German Air Force is continually pounding the railroads to the rear of the Soviet lines, while on the German side the repaired and reorganized Russian railroads are said to be carrying reinforcements and supplies to the front of the new gigantic offensive launched last week.

"The emphasis placed on these factors and the scant information released in the last few days by military quarters in Berlin are indicative of the role that railroad communications are called upon to play in the new phase of the war.

"The principal importance of the task performed by the German military engineers consists, in the Berlin view, of the possibility of moving bulky supplies by rail instead of by motor vehicles, and in the corresponding substantial saving of motor fuel."

I have dwelt on this because I go to Washington every week and am amazed how many persons there are there who have been predicting for a long time that the railroads will break down, and who seem to resent the fact that they haven't. I have heard from many who should know better, because they are well educated and well posted, that if the railroads did break down, it wouldn't matter a damn, because the motor trucks would take over the load satisfactorily. I think that is something we must keep on preaching against, because you and I know that it just isn't possible.

Proposed Program

Having established what I believe to be the railroad's right to treatment as a defense industry, I propose the following program for materials to keep the railroads functioning with full health and efficiency.

It should be recognized that transportation is vital to defense production and that the railroads will handle the bulk of the tonnage, principally heavy commodities, made up largely of iron and steel products. Their maintenance, operation and necessary improvements should be protected as carefully as the requirements of other defense industries. Of what use is defense production unless it can be fed with materials, and its production moved expeditiously, safely and economically?

The attainment of the desired goal will require the utmost cooperation. In the first place, the railroads should conserve materials for national defense by reducing their requirements of critical materials to a minimum, and by not embarking on improvements, except those vitally necessary to maintain their efficiency, and to increase their capacity quickly. For such materials as are needed in this regard, railroads and railroad supply companies, including car and locomotive builders, should place orders well in advance of use, with correct shipping schedules. Thereafter, railroads and railroad supply companies should follow carefully the first three points in the Bulletin entitled, "Priorities and Defense," issued by the Division of Priorities, Office of Production Management, Washington, D. C., April, 1941, reading as follows:

(1) Before asking for priority aid, a manufacturer should try other reasonable and customary means to solve his problems.

(2) All producers should give attention to the need for proper scheduling, which is one of the most important factors in the defense program.

(3) Any application for priority aid should be accompanied by full supporting data on the problem involved.

Ordinarily, the observance of these three points, fortified by A-3 priorities under Orders P-8 and P-21, will get all materials needed for cars and locomotives, and Priority A-10, under P-22, will secure materials for other repairs to avoid imminent breakdown. But, in addition, operations, normal maintenance, and minimum improvements to maintain and increase capacity, must be provided for.

Because of the late placing of orders, oversight, labor interruptions, a heavier-than-anticipated volume of business, or defense and lease-lend orders on high priorities, manufacturers, under the present set-up, will find it impossible to ship equipment and materials to their regular railroad customers and car and locomotive builders in time to meet their regular production schedules, and transportation delays may be threatened, if not actually suffered.

When operations, maintenance and minimum necessary improvements are threatened with delay due to the non-receipt of materials, for any of the above reasons, and the problem cannot be solved by the railroad with the supply source, an appropriate representative of the O.P.M. should have authority to issue immediately, upon request, an A-1-A or other necessary high rating for such specific items as the railroad, or car or locomotive manufacturer or supplier, states are necessary to avoid interruption of normal operations, maintenance or minimum improvement programs.

Locomotives First

Locomotives are the most important single factor in railway operation. Without them, cars would stand still on tracks regardless of their number or condition. Each locomotive out of service decreases capacity in a large way. Freight cars are next in importance, but if there is a shortage of cars, the proportional effect on service is not so serious as when locomotives are not available.

Tracks and bridges, while vitally important, are next in importance after locomotives and cars. In a pinch railroad maintenance forces can get along and keep trains moving even when materials are delayed, but such periods are limited, and materials must be furnished if a progressive decline is to be avoided. In particular, rail that is being worn out currently should be replaced currently. Delays in the delivery and laying of new rail accumulate further needs, threaten wrecks due to rail breakage, and delay the release of rails for relaying, re-rolling and scrap.

Proposed Program Detailed

Specifically, the following program is offered:

The needs of the government, lease-lend and the railroads for new rail should be ascertained for each month, months ahead, and the rail mills should be permitted to allocate enough hours to permit the rolling of sufficient rail to meet the current relaying programs of the railroads without cumulative delay. In justification of this allocation of production, it may be stated that rails can be rolled only on rail mills, while shell billets and other materials being rolled on rail mills can be rolled on other mills. Of course, there can be no objection to rolling such other products on rail mills up to the full capacity not required for rolling rail.

Blanket priorities should be issued in the following order:

Materials for operation — as distinguished from maintenance and improvements A-3

Materials for the maintenance, construction and minimum improvement of locomotives...A-3

Materials for the maintenance and construction of freight cars.A-3

Materials for the maintenance and minimum improvement of roadway, principally tracks, bridges, signals, etc. A-8

That is, maintenance is about to be covered by an A-10 rating, with no provision whatever for any kind of improvements, no matter how small.

Materials for the maintenance and construction of passenger cars A-8

The use of the above priorities should be extended automatically to the railroads. In cases where, for any reason, railroad transportation is threatened with delay, Priority A-1-A should be issued immediately on request, with the simple formality of stamping a copy of the telegraphic or mail request, the day of receipt:

A-1-A
Donald M. Nelson
Director of Priorities

The long delay pending consideration by priority specialists, processing, issuing, etc., should be avoided. That program has been presented to Mr. Pelley, and is to be presented by him, on behalf of the railroads, to the Director of Priorities of the new Supply Priorities Allocation Board. As a result, I believe our situation will get progressively better as the urgency of the railroads' need for materials is impressed.

Emergency Materials Small

The total amount of materials that would be required under Priority Rating A-1-A, in such emergencies, will not be impressive, will not interfere seriously with defense production, and indeed, by avoiding interruption to transportation, will, in many cases, expedite defense production. If any railroad or car or locomotive builder resorts to requests for Priority A-1-A more frequently than others, the transportation commissioner should be asked to check into the reasons therefor, and the privilege denied if found abused.

The importance of the foregoing program is indicated by the scope and volume of purchases of materials by the American railroads. They currently buy more than 50,000 separate items, and thus come into conflict with all defense orders. Their purchases regularly exceed one billion dollars a year, and will probably exceed one and one-half billion dollars in 1941.

Joseph B. Eastman, chairman, Interstate Commerce Commission, addressing the Association of Interstate Commerce Commission Practitioners on October 9, said that the railroads should not be deprived of the equipment they now have on order, or the materials they need for repairs. Also, that it is of the utmost importance that they secure necessary equipment and materials.

Summing Up

To sum up, the Office of Priority Management is endeavoring to give each industry the treatment it needs, but an understanding of the treatment it needs depends very largely on the presentation that is made in its behalf. The needs of the railroads have not heretofore been presented as I believe they should have been—and I have been butting in at Washington and forcing onto everybody my thoughts on this matter. I believe we are making progress and that the situation is going to get better, but I still think we need to exercise a great deal of ingenuity and not get out of patience when we don't get the material and equipment we order right on time. If they are not received on time, charge the delay to the defense program.

There is a grim determination in Washington that I want to emphasize. Whether you get it as far west as this or not, and whether you believe in it or not, the determination is that anything which can be gotten overseas at the request of the British is going to be gotten out of this country, whether we need it or not. Thank you.

DISCUSSION

President Church: Gentlemen, we have been given a picture here of unity of purpose—a picture of the O.P.M. that is not so disconcerting—a picture not so critical of the industrial executives who have gone to Washington to work for us. This address has given us a wonderful view of the priorities situation, and it all comes from a railroad man who knows. Perhaps there are questions which Mr. Smith may be glad to answer.

Mr. Smith: I will be glad to answer any questions that I can, but first, President Church, may I say that one of the reasons why I said these executives of the O.P.M. are so efficient is because I am one of them, I am a dollar-a-year man myself. (Laughter)

President Church: If Mr. Morehead, general storekeeper of the Illinois Central, is in the room, he might desire to start a discussion on this subject.

W. S. Morehead (I. C.): I think Mr. Smith's paper was very enlightening. He has told us what we in the stores department have known to a certain extent, but he has indicated that conditions, before getting better, may get worse. We have not experienced any great difficulty to date. We are ordering ahead, trying to give our suppliers as much advance information as we can on what our needs will be, and I am sure that they are working well with us and doing all they can to fill our requirements. There are some things they can't do, as have been outlined by Mr. Smith, and we are learning not to expect the impossible.

President Church: Are there in the audience other officers connected with purchases and stores who wish to join in the discussion?

Armstrong Chinn: I can't add anything to the splendid message Mr. Smith has brought us, but I am mighty glad I was here to hear his address. It has cleared up many of the uncertainties that were in my mind and has left with me a picture of what may be expected in the future.

President Church: Mr. Smith, on behalf of the association, we welcome you back. Not only have you given us valuable information, but, as one of our past-presidents, we are proud of you.

Mr. Smith: Thank you very much.

What We Can Do in the Face of A Shortage of Materials

By G. A. Haggander
Assistant Chief Engineer
Chicago, Burlington & Quincy, Chicago

(Introduced by President Church)

G. A. Haggander

President Church: What can we as bridge, building and water service men do about the problem of materials? We are facing larger work programs than for many years. We must make good the unusually heavy wear and tear on our structures. We must modernize them to meet tomorrow's changing needs. Our industry is an agency of defense. We must keep it in a constant state of preparation for the nation's demands. Mr. G. A. Haggander, assistant chief engineer of the Burlington Lines and for many years bridge engineer of those lines, is going to bring us practical suggestions on What We Can Do. Mr. Haggander.

G. A. Haggander: The situation as regards maintenance materials is changing so rapidly that it is impossible to go into detail as to what we can or should do about it. However, there are a few general principles which can be observed, largely formed from experiences during the World war.

At this time, with railroad earnings generally much better than they have been for a number of years, these earnings should be appropriated generously for restoring our properties to first-class condition. We should do all we can before the shortage becomes more acute. In any case, we should take care of certain replacement and repair work, such as bringing our painting up to date, and, in general, do all we can toward eliminating any deferred maintenance.

Must Anticipate Requirements

It is now necessary to anticipate requirements for materials much further in advance than has been necessary ordinarily. Such items as machinery, equipment, steel products, etc., must be ordered months in advance. Many of us have had the experience of ordering materials last spring for this year's program, and now find that they cannot be delivered until too late to include in that program. Orders for construction equipment, steel bridge material, etc., for next year's work should have already been placed by this time, but if they have not been, they should be placed very shortly.

Requirements for new structures should be reduced so far as possible by making heavy repairs to existing structures, or by making partial renewals. Trestles can be repaired by driving helper piles and by making partial renewals of caps, stringers, ties, etc., beyond the point usually considered economical. We have found it desirable on our road to renew enough wood pile trestles to provide sufficient second-hand repair material for the balance of such trestles, thus concentrating new material in new structures.

The matter of heavy repairs to steel structures is especially important, since the necessary materials for such repairs are now more difficult to obtain. These structures can be repaired or strengthened by adding or replacing cover plates, bracing, and other details, or by placing them on falsework, where this is permissible.

Substitute Materials

When mentioning the repair of steel structures, it is well to remind one of the possibilities through the use of arc welding, which will allow repairs to be made in many cases which would otherwise be uneconomical. Another method of meeting emergencies is to use substitute materials. In many cases it will be necessary to build structures of timbers or reinforced concrete, instead of steel. During these times we can justify much longer spans of reinforced concrete than has been the case ordinarily, because of the comparatively small amount of steel required. The other ingredients — cement and aggregates—are nearly always available. During the World war it became economical to build reinforced concrete beam spans approximately 40 ft. in place of employing steel, but with the reduction in the price of steel later, the economical length was reduced considerably.

Considerable material can be salvaged by abandoning unprofitable and unused lines, multiple tracks, or any other trackage that is not required. While the abandonment of tracks is not a direct function of the bridge and building department, those in this department are often familiar with local conditions concerning the use of tracks, and can bring them to the attention of their superior officers. Another way to help in the matter of salvage is, of course, to keep the scrap on hand to a minimum, and to ship in salvaged or unused material promptly.

During these times, it is necessary to conserve tools and equipment. They should be programmed to work full time and should not be allowed to lie idle unnecessarily. Greater care should also be taken of equipment to avoid unnecessary wear or damage. I know of several cases involving the use of company automobiles, where, because of the increased difficulty of securing replacements, those responsible are limiting the speed of their cars to 50 m.p.h., instead of the usual 60 or 70 m.p.h., in order to prolong their life.

Keep Abreast of Repairs

It is also necessary to keep well abreast of repairs, to avoid long delays when they are actually needed. Machine parts seem to be one of the items which are especially difficult to secure, largely because of the fact that those companies producing them are working to capacity to fill orders for others, or have converted their plants to other purposes. Last week I saw a machine, valued at probably $40,000 to $50,000, which is tied up for lack of a gear. The builder of the machine had converted his manufacturing facilities to other use, and could not cut the gear required. As a result, it has been necessary to redesign the gear and pinion, and secure two complete castings to replace the broken one, with, of course, long delay.

The Matter of Heavy Repairs to Steel Structures Is Especially Important—These Structures Can Be Repaired or Strengthened by Adding or Replacing Cover Plates, Bracing and Other Details

Another thing which we will have to watch carefully is the possible shortage of creosote, which was especially serious during the last World war. At that time we used certain chemicals and water gas tar as substitutes, with rather poor results. It is probable that the present extensive use of creosote-petroleum mixtures is holding the demand for creosote down to a point where the amount necessary can be obtained. During the earlier war it was necessary to use untreated timber and piling extensively, a situation which I trust will not develop during the present emergency.

It is, of course, necessary to conserve the use of cars and locomotives in company service, in order to make them available for revenue traffic. This, no doubt, is being emphasized and impressed upon you continually. However, it is more than likely that you are experiencing difficulty in keeping this matter before you because of practices that have grown up during the last few years, when equipment was plentiful. It is, of course, important also that maximum efficiency be developed in handling your work. This is another matter which I am sure is being brought to your attention often in a routine way, but which is especially important at a time like this, when every effort must be made to conserve labor, material and equipment.

DISCUSSION

President Church: We have had an interesting message from Mr. Haggander and are now ready for discussion.

Armstrong Chinn (Alton): I am sure that I can't add anything to Mr. Haggander's paper. However, in his opening remarks, he stated that this is the second time he had addressed this association, and so we must have thought him good before. Apparently, when his management found out that we thought so well of him, it wasn't long before they promoted him from bridge engineer to assistant chief engineer; and now that we think him good enough to have him back a second time, I wouldn't be surprised to hear of something further soon. (Laughter)

Elmer T. Howson (Ry. Eng. & Mtce.): As I listened to Mr. Smith and to Mr. Haggander, the thought occurred to me that if they were to say in one sentence what they thought the bridge and building man ought to do, it would be to encourage him to become more largely the master of his own problems — that he might reduce the need for materials by conserving that which he already has, by using that which he has most intelligently in order to make it last as long as possible.

In railway organizations, the maintenance of way officer has been accustomed to tell the purchasing and stores department about his needs and then expect that the replacement part, or the new material, will come along on the date he requires it. That is a service that he has been taught to expect by the efficient way in which the purchasing and stores department has functioned. But now there is a problem which is beyond the scope of that department in many respects, and much of the responsibility for meeting the situation comes right back to the user. It isn't a supply problem; it is a problem of using and making the most of what we have, using it and then repairing it or carrying on with it; and that supervisor will make the greatest progress who is most versatile in anticipating and meeting his requirements in the field without even calling on his stores or his purchasing department, except as a last resort.

Much We Can Do

There is much we can do that we normally do only in times of necessity. There is one process that has become very highly developed in this country, a process that really had its birth during the last war and the depression that immediately followed. That is the process of making over and repairing by welding. I think we are going to do more of that, and that we are going to do it with the motive of helping our national objective right now. The railways are going to require more materials because they are going to have more work to do, and they are going to have to work out their problems so far as they can by themselves.

The mail I am receiving these days makes me quite sympathetic with the things that are going on in the organization which is developing this priorities system. The railways are high up in the scale of priorities. There have been some difficulties in getting materials, but, as Mr. Smith stated in the closing remarks of his address, the trouble is not all with the system. Some of it is with the use to which that system has been put by the railways. As the railways become better versed in the necessities of the situation and the routine that must be followed, I think many of their troubles in getting materials are going to disappear. The railways are in an enviable position; they are second to very few industries or groups, other than the army and navy, in their importance to national defense. I think Mr. Smith will agree that the attitude of the government in Washington is to see that the railways are supplied with the materials which they really need, but that they must show that they really do need them.

Railways Will Survive

We are working out of this. We are going through a tremendous revolution. We can't help but have some uncertainties. But with a display of common sense and ingenuity on the part of the railways, and with a willingness on their part to prepare their case to submit to the fair-minded men who are trying to work out this terrific problem of adjusting distribution, the railways are certain to come through and will be permitted to continue to function as a vital agency of our national defense.

President Church: Thank you, Mr. Howson. Will Mr. Duncan of the Burlington give us any information which he has on the conservation of the materials we use, and concerning the probable extension of life of such materials during this period?

The Creosote Problem

H. R. Duncan (C. B. & Q.): I doubt if I am qualified to give you much help. I can speak mostly about timber. However, I think Mr. Haggander would be in a much better position than I to say what longer life might be secured from the treated material that we furnish him. Of course, we think we have done a good job, and we believe that we are going to get long life from our material.

I am somewhat apprehensive about the creosote situation. Some railroads have been able to secure what they have needed for their present requirements; but there are quite a number, particularly those dependent on imported oil, that are having difficulty getting what they need. As a result of that shortage, they are now substituting leaner mixtures of creosote. For instance, some roads that have been using creosote-petroleum mixtures of about 50-50, are now using a 30-70 mixture, ie, 30 per cent creosote and 70 per cent petroleum. Others are using 25 per cent creosote and 75 per cent petroleum. They are also considering other chemicals. I do not know of any road that has decided to adopt any of these substitute measures as definite standards, but an effort is being made to spread the creosote around so that it will go as far as possible. What I am apprehensive about is, whether we will be required to spread it so thin that it won't do what we want.

As Mr. Haggander has said, during the last war we used some of these substitutes and got by all right, but some of the structures built then haven't stood up as they should have. We can't look at some of those structures with the same pride with which we can look at some of the 1904 and 1905 bridges built on a number of railroads—structures that are still in service. Some of those built 20 years ago with the substitutes have already cost a lot of money and time in replacements. Some of them need to be replaced right now.

I don't have the answer; but in the American Railway Engineering Association we are giving these things consideration and when we are forced to do something, I think we will be ready with the best answer that is available at the time.

President Church: There is one more question I would like to ask. We have had discussion on what we should do in caring for and sorting scrap, and it is recognized that the bridge and building department can co-operate immensely in that respect. Has Mr. Duncan anything in mind in connection with what the B. and B. forces can do in segregating second-hand bridge timbers which might be retreated or reframed, and putting them back into structures to increase their effective life?

Mr. Duncan: I can't speak for all railroads on that, but here is my personal idea. If any of the material released is free from decay and is or can be made into the proper sizes, there is no reason why it cannot be treated and used effectively. Usually it will make a good permanent structure. The important thing is to see that it is free from decay. I would not advocate the re-treatment of any decayed material.

President Church: Would you say it would be practicable to reframe timbers which have been treated before?

Mr. Duncan: If the whole stick or that part you intend to use is free from decay, I wouldn't hesitate one minute about using it.

Mr. Chinn: There is one question I would like to ask Mr. Duncan. You speak of a shortage of creosote. I suppose it is being diverted to other uses, and I am curious to know what they are.

Mr. Duncan: The creosote situation is considerably different than it was during the previous war. We are in much better shape than we were then, for the reason that prior to the previous war the bulk of the creosote used in this country was imported. During the war and immediately after, methods of creosote production were greatly improved in this country. We now manufacture in this country in the neighborhood — this may not be exact—of 75 to 80 per cent of what is used. These figures are the reverse of what they were before the previous war. Then, 75 to 80 per cent of the creosote was imported. Of course, we are using much more creosote oil now than we did then, but I don't think it is possible to be as short now as we were before.

The reason for the shortage is due primarily to the fact that the oil is not being imported. I understand there has been none brought into this country this year, or, if there was any, it was in January. This is because they are holding it abroad to be used as fuel; and there are other things in defense work derived from creosote.

There has also been a shortage of tankers. I was talking yesterday to an importer who owns a number of tankers. He told me that negotiations are now going on and that it is likely that Great Britain will release some creosote to us in exchange for petroleum oil. I don't know if that is wishful thinking or if we are really going to get some, but I think it is possible that such a deal might be arranged. It has been said that they can't get the tankers back here. Every time a tanker unloads its oil, it has to go three or four places to get a load of creosote, and after each move, it is necessary for it to wait for convoys. They can really get the tankers back to this country more quickly than they can load the creosote. However, the proper procedure will probably be worked out.

Mr. Chinn: Then it is just a matter of imports, and not one of new uses to which creosote is being put.

President Church: I would say, Mr. Chinn, that there is also a tendency on the part of the by-products people, who are closely allied with the steel industry, to use some of their tar for fuel.

G. S. Crites (B. & O.): The first supervisor of bridges and buildings that I contacted was a Scotchman. That was during the Cleveland depression in the early Nineties. It was surprising how well he did with second-hand materials while his road was able to buy little or no new materials. Since then I have met many master carpenters and supervisors of bridges and buildings, and their resourcefulness astonishes me. The old Scotchman would be proud of them if he were living today. All bridge and building men cannot be Scotchmen, but they are thrifty in the use of materials as a general rule.

President Church: Thank you again, Mr. Haggander. The meeting is adjourned.

Welding in Water Service

Report of Committee

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J. P. Hanley
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One of the outstanding developments in labor-saving devices and methods of doing work on the railways in recent years has been the extended use of oxy-acetylene and electric-arc welding in the mechanical and maintenance of way departments. Through the research of the metallurgist, the fusion and adhesive qualities of metals and alloys have been under constant study, while at the same time the design of welded joints and the methods and technic of welding have shown consistent improvement. The practical application of welding has been receiving engineering study on the railways recently to widen its use, and this study has developed methods for bringing various types of welding work under standardized control and costs.

Like many other widely-used inventions, the beginning of welding was of humble origin, and its development was a step-by-step process. Oxy-acetylene welding may be said to have been discovered in France in 1895, when it was found by a French chemist that the combustion of oxygen and acetylene combined produced a flame of unusually high temperature. In the same year a machine was developed in Germany for the production of oxygen from liquid air. In 1901, the blow pipe was developed in France for combining and burning oxygen and acetylene. These three basic factors in welding were developed and improved for the most part, by separate companies in Europe and the United States. Many small companies, in turn, have been merged into a limited number of large corporations, which now develop, manufacture, sell, lend and lease a wide assortment of welding materials to the railways and others users. The advent of the World war in 1914 increased immensely the use of welding for the repair and construction of war equipment. After the war, industry took up the use of welding extensively for the repairs, and also for the manufacture, of many products.

The use of welding on the railways started in the mechanical shops, and has now been extended to all branches and divisions. Indicative of its now general use is the amount of oxygen and acetylene gas purchased by one mid-western railway (with approximately 6800 miles of lines) during the calendar year 1940, which included 23,781,900 cu. ft. of oxygen gas and 9,351,018 cu. ft. of acetylene gas. Of this amount, 4,832,100 cu. ft. of the acetylene gas was generated at the point of use, while the balance of both gases were received in cylinders and used at points ranging from small isolated jobs to medium size shops. Water service repairmen frequently use one cylinder of each gas, which they transport from job to job in their trucks or automobiles. They also usually have an oxy-acetylene welding outfit on their camp and tool cars. This equipment offers decided economy in removing old piping and in installing and repairing new facilities.

It is regrettable that the water service department was about the last department on the railways to adopt this modern process, but the replies to a questionnaire by your committee indicate that the majority of the water service departments now use welding equipment, and that their men are becoming competent in its use for the purpose required. Welding in the water service field is not of the complicated or highly expert type. The equipment is generally used in joining and cutting wrought pipe, in melting lead joints in cast iron pipe, in repairing castings, and in thawing frozen water lines.

Information and suggestions submitted by committee members regarding water service welding practices on the several railways with which they are personally familiar, are presented in the following statements. In these statements, the railways have been designated alphabetically, but their names, as well as the names of the committee members who furnished the information concerning them, may be secured if further details are desired by members of the association.

Road "A" Sees Advantages

A portable oxy-acetylene welding outfit should be furnished each water service gang. There may be isolated locations where electric welding may be resorted to, but such welding is usually of a special nature.

On this road, oxy-acetylene welding is used almost exclusively for making repairs to pipe lines in yard distribution systems of air, steam and water, and for similar repairs in shop and roundhouse systems of hot and cold water, steam, air and blow-down and boiler washing lines. It is also used for general repairs to power-house lines. Welding is also resorted to for the installation and repair of manifolds, headers, exhaust heads, separators, exhaust tank heaters and radiators, sand pipes and fittings, stove and furnace stacks, blower lines, hand rails, coaling station facilities and equipment, and for many other classes of work. No attempt, other than for emergencies, is made to weld pipes or tubes of a diameter less than ¾ in.

For new work around terminals, beveled-end pipes and fittings are ordered, ready for welding. This generally does away with unions, which are a source of trouble. Welded connections simplify repairs and reduce friction. Pipe work located at points away from terminals is not welded as yet, except for repairs.

The advantages of welding by water service gangs are many. Reductions, bends, tees, ells and branch connections can be welded in place more satisfactorily, and in about half the time required for screw connections. In repairing a leaky joint, a short piece of pipe can be spliced into the pipe and welded, making a secure job.

Trenches do not have to be as wide at joints or connections for welding as they do where pipe tools must be used. Tunnels that will admit a man will usually permit welding, and welded pipe takes up less room and slides through a conduit more easily.

At locations where vibration exists, it is found that welded joints, fittings and connections are much less likely to leak than screw connections. Usually too, unions can be eliminated, and welding produces a neater job.

The welding of pipes, tubes and fittings for both new and repair work is generally recommended in large terminals, yards and power houses. There is still a place for screw joints for small installations and for small pipes and exposed plumbing fixtures.

Pipe installations in buildings should be welded in sections on the ground and the sections then hoisted and welded in place. Scaffolds and tackles should be strong and well designed. With careful planning, pipe work of pleasing appearance can be installed safely and economically.

Road "B" Does Little Welding

Water service maintenance men on this railroad have definite territories to cover. Individual maintenance jobs are usually handled by one man. The majority of the territories are outside the large terminals, where the bulk of the pipe work is underground. No welding outfits are assigned to maintainers, and few have had experience in operating welding equipment except for thawing pipe lines. Welding equipment is not assigned to the water service organization.

Pipe maintenance work above ground in the larger terminals is handled by mechanical department forces, who have done considerable pipe welding work during the last few years. While no figures are available to verify the statement, it is felt certain that substantial economies have been effected as a result of pipe welding at shops and roundhouses.

On existing water facilities, where cast iron pipe has been used there is little opportunity to do maintenance work with welding equipment. Field-welded pipe should be given consideration when new pipe lines are being planned, with the view to the most economical maintenance of these lines.

There are instances where items of equipment can be repaired more satisfactorily by welding, but these instances are so few that it appears more economical to have such done by a local welder as it arises, than to wait to have the work done by company-owned welding equipment, which might not be readily available.

It is believed that insufficient welding is required in water service work outside of terminals to warrant the purchase of welding equipment and the expense of training water service maintenance men in welding work. Water service men should, however, have a general knowledge of the uses of welding, as applied to their respective needs.

Road "C" Makes Extensive Use

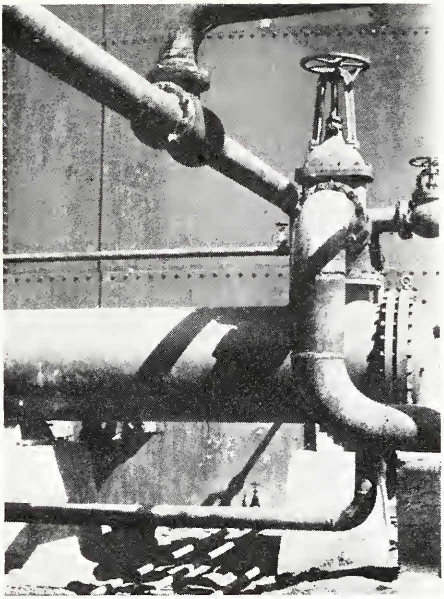
All of our pipe fitters, plumbers and water service men, and their helpers, have taken up the study of welding, and practically all of them are good welders. These men were given opportunity to learn the handling of the cutting and burning torches, were supplied with literature covering this equipment, and were instructed in the art of welding by instructors furnished by the service company which maintains an organization in this vicinity. Almost any good water service man or plumber can, in a short period of time and with a limited amount of training, become sufficiently skilled to do the ordinary pipe welding encountered in general water service work.

More welded joints are used in our pipe lines than old style threaded joints, and welding is performed wherever possible in preference to threaded joints, as it makes a better job, with less likelihood of leaks. Several extensive jobs have been completed with all-welded joints, elbows and connections. In some cases, special welding elbows, tube turns and flanges are used, and the pipe is purchased with V'd ends, ready for welding. In other cases we make the elbows, tees and fittings, especially in the small pipe sizes.

Advantages

One of the advantages of welded pipe lines is the ease with which a connection can be made to an existing line. Instead of cutting, threading and installing unions or flanges, a hole of the required size can be burned in the main and a welding nipple inserted with a valve on the end. As soon as this piece is welded in place, the main line can be restored to service.

In all connections of this character, a saving is made not only in time and material, but also in the time that the main line is out of service. Welded connections have been made to a 2-in. steam line enclosed in a box conduit, at a cost of 70 cents for labor and material. In this case, it would have been impossible to cut and thread the pipe in the usual manner without disconnecting the pipe and removing the encasement. In making connections to existing water lines in cramped quarters underground or overhead, the welding method is a time and labor saver, not only reducing the time formerly spent in cutting and threading pipe, but also on excavations, staging and incidental work.



The Welded Fittings in This Pipe Line Installation Provided Practical Advantages and Effected Substantial Economies

At an isolated point on a branch line, a tank was supplied from a water ram which had been in service for 30 years. The main body casting of the ram broke in two while in service, putting the water supply out of service. The ram was disconnected, brought into headquarters by truck and was welded by one of our pipe fitters. The cost of the repair work was $19.70, as compared with a cost of $55.30 for a new repair part. In addition, a delivery delay of several weeks was avoided.

Welded lines can be bent around floor beams, posts and roof rafters without special elbows, flanges or unions. This effects savings in labor and material and permits installations where screwed or flanged pipe cannot be used on account of lack of working space. A welded line has a much better appearance than a screwed or flanged line, as it is practically the same size throughout, permitting covering without unsightly bulges over threaded connections.

No special organization is set up for ordinary bridge and building work, except that tools and welding apparatus are made available for each man. A grinder for making V-joints would cut the cost of preparing materials for welding, but in most cases this has to be done by hand, particularly where the lines are overhead, underground, or in cramped quarters. For large installations which can be programmed for a specified time, the use of power grinders and cutters should be considered, and the crews that are to do the work should be organized and trained.

Outfit For Each Gang

A welding outfit should be made available for each water service man for use on the line, and another should be furnished for shop pipe fitters. All divisions on this road are equipped with acetylene welding outfits, but the men are not familiar with electric arc welding. Cutting with the torch, particularly if the old line is to be scrapped, can be done in a fraction of the time required to uncouple and remove a line in the ordinary way. Lines can be cut into short lengths for easy handling.

Blow pipes and regulators are supplied by the service company while the hose and tips are furnished by the railway. The outfits are serviced by the company supplying them, which also provides instructors to supervise special jobs and to instruct employees in case they have a job requiring expert advice.

Cost of Outfits

In addition to the cutting and welding blow pipes, regulators and adaptors which are supplied by the service companies free of charge, the following items, with their approximate cost, are required to be furnished by the railway.

100 ft. of hose, couplings and clamps	$19.06
1 Pyro lighter	.26
1 pair welders goggles	2.10
1 pair welders gloves	.75
6 welding tips	31.77
1 gas cylinder wagon	10.00
	$63.94

This provides an outfit that will take care of practically all ordinary bridge and building and water service work.

On this division, water service men and pipe fitters do a considerable amount of welding other than on pipe for water service, and many jobs that are handled ordinarily by the bridge and building department, both in terminals and on the line, including repairs to machinery, equipment, coaling plants and turn-tables, are taken care of by these men. On a large welding job, acetylene gas can be generated at the site of the work by the use of generators offered by any of the concerns catering to this trade. Gas generated in this manner costs less than that furnished in cylinders.

In repair work by welding, or in making connections to existing lines, operators can work in very small and cramped quarters, if necessary, and can burn a hole in a pipe line and weld in a connection where it would be impossible to make the ordinary screwed connection. Practically all pipe work in roundhouses, stations and greenhouses for both steam and water is carried on by welding. It saves time, labor and expensive parts, and makes possible pipe connections which could not be made in the usual manner.

A recent job consisted of the installation of a 10-in. high-pressure valve in a steam line extending from a roundhouse power room. A short section of the main was removed with the cutting torch and the valve welded in place in four hours by a welder and a helper. This eliminated the expense of machine-cutting and threading the 10-in. pipe, which was located near the ceiling of the power room, and also the use of two 10-in. flanges and gaskets, and restored the line to use much more quickly than would have been possible if the valve had been installed by threading and flanging in the line.

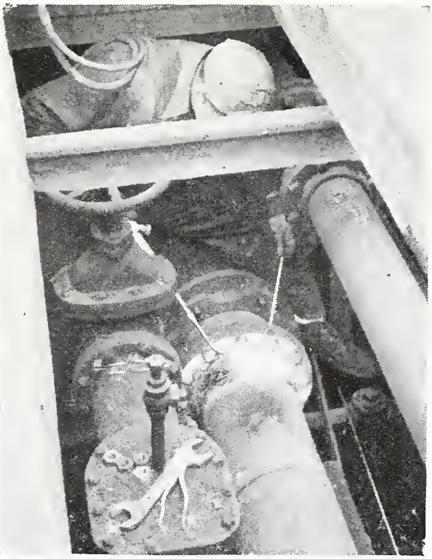
From experience, it is found that the practice of welding pipes in water service work is much superior to the old method, and is bound to increase as its advantages become better known.

Road "D" Has No Specialized Welders

Specialized welders are not employed as a rule and welding is carried on by different members of the bridge and building department who have received some training. It is believed that considerably better results could be obtained if all welding was done by a trained welder, and on parts of the road this practice is followed with good results. On other parts of the road, electric arc welding has been used to advantage.

Welding in water service is of advantage in saving time and in reducing the number and type of fittings required, and the completed work generally has a better appearance than screwed or flanged joints. In removing old piping and equipment, the acetylene torch saves time, particularly in places that are hard to get at. Where the material is to be scrapped, the acetylene torch is especially preferable to disconnecting.

The acetylene torch is found useful on steam and water lines in conduit boxes, where the pipe is split or where a small hole is causing a leak. It saves the work of removing the pipe, and, if a reasonable opening is provided in the conduit, no unfavorable reaction is caused by the fumes.



Welders Can Work in Very Small and Cramped Quarters, as Is Indicated by the Welding Being Done in This Pipe Tunnel

Where the quantity of work to be done is sufficient, a trained welder is of advantage, but where the work in the territory is so small that a trained welder cannot be employed continuously, it is better to continue with the screw or flange-type joints. Water service maintainers become fairly proficient in welding if the amount of welding done is sufficient to keep them in practice, but if the work is intermittent, they do not maintain proficiency.

11 Divisions on Road "E" Are Equipped for Welding

The water service department of this railway has 12 division gangs and one system gang. Eleven divisions use welding in water service work and have one or more oxy-acetylene outfits in their gangs. One division also uses an electric welder for shop work and cast-iron welding, and for thawing frozen service lines. The system gang uses the oxy-acetylene process and puts it to a great many uses, including welding and cutting wrought and steel pipe; brazing and repairing well screens, well casings and drop lines; and salvaging and repairing valves and fittings. A considerable number of the personnel of the system gang and of the division gangs have become competent in welding and cutting, and the balance of the men are very much interested in the process and are practicing to become competent whenever they have opportunities. The supervisory officers encourage and assist those repairmen who show interest.

Find Valuable on Road "F"

Acetylene welding has many advantages in water service. In my territory on 225 miles, the men would be stranded at times without a welding outfit. As the result of welding, one-third of the fittings used 15 years ago are no longer required, which is a large factor in economical water service maintenance. Welding is used for all kinds of repair work, including castings, aluminum, brass and copper.

In installing valves, large and small, in wrought piping, the valve is fitted with short nipples; a section of the line is cut out; and the valve assembly is then welded in place. Water column castings are repaired without taking the column out of service. In fact, anything that breaks in water service is repaired at a generally lower cost than the cost of repair parts.

The acetylene torch is 100 per cent useful in removing and cutting down old pipe systems and in salvaging and repairing second-hand valves and fittings for future use. The welding torch can be used successfully in pipe tunnels and other cramped locations. In these places, if no draft prevails, a fan should be set up behind the welder to furnish air circulation for removing the fumes and for providing fresh air. Welding should not be done on the inside of sooty smokestacks, as the soot may explode when heated. The acetylene valve should not be turned on in closed places. The torch should be lighted before entering. All water service men should be good welders as they cannot handle their work economically at the present time without using this process.

The use of the electric arc in welding has been known for more than 50 years. The original patent was granted in Russia in 1887. This patent covered the carbon electrode process. The patent for the metallic electrode process was granted in 1889. The industrial world was slow to develop the possibilities of electric welding until the World War demonstrated its usefulness in the maintenance and repair of military equipment. The great expansion of industry after the war gave electric arc welding a vast field for use in the maintenance and repair, and also the manufacture, of many industrial items. The use of the covered electrode welding rod made possible a distinct improvement in the application and speed of depositing the fusing metal. The discovery that this process permitted the economical welding of such metals as manganese and cast iron also increased its use.

The use of electric welding is increasing in the maintenance of way departments of railways for repairing manganese frogs and crossings in place. The water service department of one railway reports the use of a mobile electric unit for thawing frozen service pipes. Another road uses this type of welding for repairing damaged sections of cast iron heating furnaces without their removal.

One mid-western railway has 17 electric welding outfits in its maintenance of way department. These outfits are operated by gasoline engines, or electric motors, as conditions require, and are skid, truck or tractor mounted, depending upon their location. An outfit of the 40-50 h.p., heavy-tractor-mounted type, having a 300-ampere welding current, was purchased recently at a cost of $3,342.

Some of the smaller welding outfits owned by the railway referred to are located in the division work-equipment shops, and the mechanic in charge performs a community electric welding service for the various subdepartments, including the water service and bridge and building departments, in addition to maintaining the maintenance of way track equipment.

This arrangement results advantageously to the water service department, which may thus have many kinds of castings repaired by electric welding, where this type of welding is superior to the acetylene process.

Conclusions

(1) Welding is now generally recognized as a necessary process in water service, as well as in other departments of the railways, and equipment and training are being supplied to water service men by most railroads.

(2) Acetylene welding outfits are much more numerous than electric welding outfits, although water service men can usually obtain the advantage of the latter form of welding by taking their work to the division maintenance of way or the mechanical shops.

(3) In some instances, portable electrical welding outfits are being used by water service men for thawing frozen water pipes and for welding heating-furnace and other castings without their removal.

(4) The greatest use of welding outfits is in welding and cutting wrought pipe, in melting lead joints in cast iron pipe, and in improvising alternate arrangements where standard fittings are not on hand.

(5) It is recommended that welding outfits be supplied to water service men where outfits are not now available, and that supervisory officers make arrangements to supply the necessary training to the men and to otherwise encourage them to become proficient welders to such extent as is useful in water service work.

DISCUSSION

President Church: We have had a very interesting and timely report from this committee, and we now welcome comments regarding it.

G. S. Crites (B. & O.): Under the summary of the practices on various roads, under Road "D," the last paragraph should be deleted from the proceedings. I don't think it is constructive. When a person once gets to know a thing, he doesn't lose proficiency. There will be ample work for the welders, even if only part-time welders, to maintain their proficiency.

This is a very timely subject. We haven't covered it at this time from the standpoint of conservation of materials, but it has a very definite bearing along those lines. Recently, it was necessary to augment the water supply at a water station by extending a pipe line to another source about 2500 ft. away. It was impossible to get new tubing, but there was some obsolete boiler tubing available that wouldn't fit into any boilers then in use. This tubing was quickly assembled and hauled onto the ground. There it was cut with rollers which put a "V" on the ends. The sections were welded in lengths of about 500 ft. and these lengths were then dragged alongside the trench and there welded together into long stretches. The completed line was then dropped into the trench.

This was a case of conserving materials—of using materials that otherwise would have been scrapped, for securing a water supply quickly. If the ingenuity of the water service force and the supervisor of bridges and buildings hadn't been brought into play, there would have been a shortage of water and an interruption to transportation. That is an illustration of what water service men and supervisors of bridges and buildings can do in an emergency.

Avoid Fire Hazard

The suggestion on Road "A," that pipe connections of intricate design, with many branches, such as may be used in power houses, or in shops or around enginehouses, be fabricated on the ground and then hoisted into place and welded, brings up possible objections. Railroad officers have been hesitant about allowing either acetylene or electric welding in shops, enginehouses and coal tipples because of the fire hazard. A good practice in such cases is to have an ample number of fire extinguishers readily available and always to have two or three buckets of water within reach to quench a fire which might get started, especially if in a dry, dusty place.

The welding should never be continued right up until quitting time, when the men leave the premises. Sparks may get into the cracks and other places in a building where there is dust or grease, and smolder for some time before bursting into flame. In conducting welding operations in locations where the fire hazard is great, it is best to perform the work early in the day so that workers are around afterwards; otherwise leave somebody on watch after the work is completed. A still better practice is to weld the pipes and connections outside the building where there is no danger of fire. Then you can utilize the time at the end of the working period for planning and getting your work together so that you can start hoisting and welding the pipe in place the next morning when there is less danger that a spark might get away from you and start a fire. That will utilize your time effectively and is good safe practice. Fires in power houses, machine shops and coaling stations have been caused by both oxy-acetylene and electric welding, but they can be prevented.

President Church: May we have further discussion on this valuable report? We are getting good information in this discussion.

Many Uses on I. C.

C. R. Knowles (I. C.): We had a very severe drought in Southern Illinois during the last summer. As a matter of fact, we have had a drought there for two years. In the construction of an emergency station, we found oxy-acetylene welding of particular benefit because it was difficult to obtain the necessary fittings. In constructing the emergency water stations and other facilities, the welding process was used almost exclusively for making connections in wrought iron pipe laid above ground. Welding in water service is used chiefly on lines above ground, rather than on underground lines, although it is applicable as well to underground cast iron mains.

Another use for welding in water service is in placing bronze on the lower ends of water column lines where the lines pass through the packing into the water column valve box. As a rule, these water column lines are of steel pipe and corrosion is rapid, resulting in the necessity for frequent renewal of the packing. We take these lines which have become corroded, coat them with bronze, and then turn them down. With such treatment, we not only avoid the necessity for a new column, but we also greatly prolong the life of our old columns. We are endeavoring, too, to get the water column manufacturers to furnish bronze on new columns.

Mention has been made of the use of welding outfits for thawing. In some cases, the oxy-acetylene process is adapted to thawing pipes. Generally, however, electricity should be used. We use it quite extensively. We have portable electric outfits in our maintenance of way department which we use extensively during the winter months, in extremely cold weather, for thawing underground pipe lines.

As the committee has stated, the use of welding equipment in water service work has developed slowly. However, I think we are going to see a very decided increase in the use of electric welding by the water service department.

Weld Steel Tower

L. D. Garis (C. & N. W.): A few years ago there was a failure at one of our cinder-handling plants, at Proviso, the principal freight terminal of our road. It happened that some of the officers in charge of that territory were absent, and in taking care of this emergency, the general office sent me out to see what could be done about it.

The part of the cinder-handling plant that was damaged consisted of a structural steel tower. A bucket ran in this tower as an elevator, and a spout delivered the cinders into gondola cars. The spout, or apron, wouldn't clear a freight car or a locomotive, because such a piece of equipment had been run into it while it was down and had twisted the tower into about as bad a mess of wreckage as I have ever seen.

I was supposed to advise whether to wreck and scrap this steel tower or buy a new one. Being a bridge inspector, I took one look at it and decided that the only thing that could be done was to scrap it, and I so reported to the engineer of bridges.

It happened that very soon after I left the scene of the accident, the supervisor showed up. He knew some things that I didn't know, and said that he thought the broken and damaged parts could be welded. He consulted with some of the water supply welders and they stopped the order for the new structural steel tower. He then secured a lot of steel angles from the scrap bin and brought a gantry crane to the job. With this equipment, this steel tower, which had been twisted around nearly 45 deg. by the accident, was twisted back in place. They then welded some of the angles taken from the scrap pile into the steel frame, and in about 15 hours the cinder-handling plant was again in operation.

For Furnace Repairs

Mr. Crites: There is one very important point that was touched on under electric welding, and that is relative to repairs to furnaces. Cast iron furnace sections can be electrically welded. This can be done quickly and the heat turned back into your building without much inconvenience. I have one furnace that blew up. The water was let get low in it while under fire, and cold water was turned in. Four sections were badly shattered. The electric welders had the sections repaired and the furnace back in service within ten hours. These welded sections are holding after their second winter in service.

Armstrong Chinn (Alton): This report is very timely and points out things we are going to do from now on that possibly we haven't been doing in the past. As Mr. Garis and Mr. Crites have mentioned, welding can be used to conserve materials, and you who have heard the several addresses on what we are going to have to do about materials in the future, and for some years to come, know that we are going to have to find ways to conserve the materials we have on hand. I know of no better means for doing this in bridge and building work than by welding.

I said recently to Mr. Hunter of the Oxweld Railroad Service Company that his business usually got better when the railroads, either because of depressions, or because of better business in the country, such as we are now having, find it difficult to get materials. We then resort to welding to use and conserve the materials which we have.

Not a "Cure-All"

Welding is useful in our business, but we need to exercise caution in its use. In one place, the report mentions how easy it is to use a torch to remove pipe lines. Well, that also applies to removing other metal materials. In fact, a cutting torch makes such jobs so easy that sometimes it will be used where it should not be used. In other words, to make work easy for themselves, men sometimes use the torch to cut out materials that should have been preserved for future use; and since it is going to be so difficult to get materials from now on, we shall need to watch that phase of it.

Mr. Crites: A water shortage in our territory made it necessary to get augmented water supplies in several places, and again the ingenuity of the bridge and building forces was brought into play. Here, by means of welding, we set up two 4-in. penstocks on water mains supplying industries. They are small, simple and plain, but they delivered from 800 to 1200 gal. of water per minute.

President Church: Mr. Hanley, we are pleased with this excellent report. You and your committee are excused with the thanks of the association.

Efficient Methods of Transporting Water Service Gangs

Report of Committee

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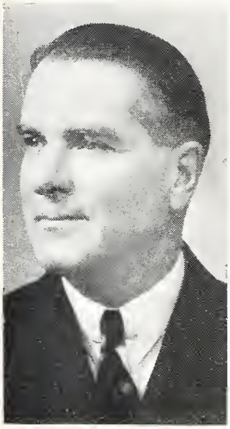


S. S. Long
Chairman

The fact that this subject was chosen by the association for study during the year, convinced your committee that there exists some, if not considerable, apprehension that the methods now employed by many railroads in transporting bridge, building and water service employees, are inefficient. Accordingly, it seems advisable to review briefly the circumstances from which the methods developed which are more generally employed today for transporting men to and from work, the objections that there may be to such methods, and finally, the improvements that are available and that offer opportunities for substantial economies.

Years ago, when railroad construction was a major undertaking, tracks were advanced through unsettled regions, across plains, through forests and over mountains—all mainly in wilderness where the housing and feeding of men were necessarily the first problems for which arrangements had to be made. It is readily understood why camp cars came into existence as a practical means of caring for a large number of men whose work was continually pressing forward, because the mobile camp, conveniently handled on the newly laid rails, solved that problem well.

As parts of new lines were placed in operation, these large camps became fewer or disappeared, to return only with infrequency when extensive rail renewals or ballast work demanded their use. But the maintenance of track, bridges, buildings and water supply facilities called for means of taking care of small groups of workmen, some of whom, by reason of their duties, had to be moved from one locality to another, often for emergency work and over long distances. Among these were the bridge and building gangs and the water service employees whose small camp units, generally known as outfit cars, naturally became not only common, but afforded the most practical and economical solution. The cars could be moved from one siding to a distant one, or could be spurred out to place the men within reasonable operating limits for their hand car, or, in more recent years, their track motor car.

During the long period in which the old reliable hand car not only took the men to and from their points of work, but often enabled employees, and others as well, to reach towns where they could enhance the gate receipts at dances and other places of interest, there were only dirt roads or trails, often few and far between, and no motor vehicles. The railroads were necessarily depended upon for local as well as long-distance transportation of persons and property. Locomotives and trains were relatively small; they operated frequently; sidings or spurs were numerous, so that outfit cars could be moved promptly from place to place and material could be distributed at bridges and other points between stations with little detriment to train operation. Neither was there serious loss of time to gangs in those days of longer working hours, when the delayed way-freight might arrive at the unloading point at an hour that would now be far beyond quitting time in the zone of overtime, an unknown headache in those days.

Conditions Have Changed

But look at the picture today. Train makeup and operation, both passenger and freight, have changed radically. Runs between stops are long and at high speed, and extra stops, or even slow-downs cannot be justified. Neither can present-day heavy freight trains be used to pick up, move and set out outfit cars without disrupting and penalizing the cost of train operation. Way freights, as we used to know them, have, to a large extent, disappeared, so, in addition to the problem of getting outfit cars moved and moved when the progress of the work requires, there is little opportunity to provide train service economically for the unloading of small amounts of material between stations. Changed passenger service has greatly reduced or eliminated the opportunity to send men to points where perhaps a small repair job must be taken care of quickly, or where a car must be released of its load. Men in outfit cars can no longer get to their homes over Sundays without entailing a considerable loss in productive working time during regular hours.

Because of the changed character of train service, the track motor car, which has been gradually improved so that, under proper care, it is reasonably dependable, has been pressed into the long-distance hauling of heavy material and of men. Both of these factors add to the hazards of motor car operation and increase maintenance costs materially. The difficulties of track car operation have been greatly increased, not only because of the faster and heavier trains now prevalent, but also because of the elimination of many communicating stations, which decreases the opportunity to keep in touch with train movements.

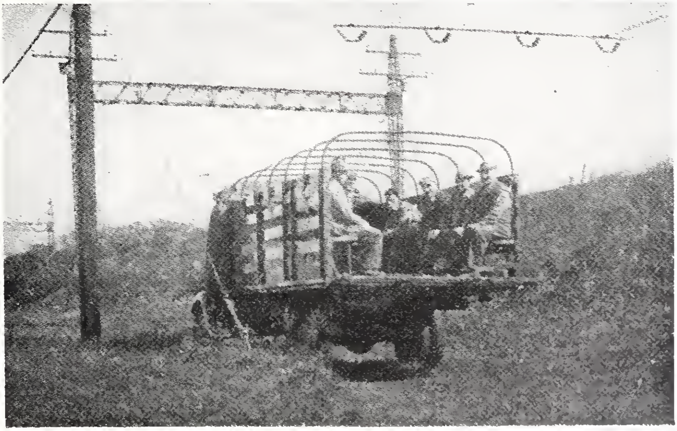
Coincident with these outstanding changes in operating conditions on the track, improved highways have been developed, which in numerous instances parallel our railroads and pass the bridges and other intermediate structures in reaching towns or stations along the way. Furthermore, these highways checkerboard the land, radiating as the spokes of a wheel from the larger centers, with the result that short-cuts have been established between many railroad stations, particularly on those lines that cross each other, or which tend to parallel each other, though perhaps at remote distances.

These highways have been built and improved for the declared, if not the actual, purpose of serving the public needs. The railroads have contributed largely to their cost in one way or another—yes, have often paid unfairly and dearly. Why then, should not the railroads avail themselves of all the opportunities there may be to use these highways advantageously in accomplishing their primary purpose—that of mass transportation of persons and property on the rails?

One field for such study lies, unquestionably, before this association—that of transporting workmen with minimum travel time, and of supplying them with material by a means that will insure its delivery when needed, with the minimum elapsed time between the store room and the point at which the material is to be put to use. First, let us explore the possibilities of transporting bridge and building gangs. Necessarily, at the larger terminals, such maintenance forces are centralized and are maintained in greater numbers than elsewhere. It is there that workmen have their homes and are available when conditions require increasing forces, perhaps quickly, to cope with some emergency. It is there that the stores department is represented and has the materials and tools we need.

In many instances, a railroad has more than one line through such terminals, but, in any event, there is much nearby work for bridge and building men at such points, with their terminal buildings, street subways, suburban stations, interlocking towers and industrial tracks with their bridges and coal trestles. Gradually as the distance increases from the center of large terminals, the bridge and building work becomes more scattered and decreases per mile of railroad. Relatively, similar conditions exist at the smaller terminals, the natural headquarters for maintenance forces. At these latter points there may be, in addition to company buildings and other facilities, various industrial tracks, including mine tracks, on which bridge work is necessary. At all of these terminals track car operation is difficult, if not impossible, because of frequent train and switching movements or cars blocking the tracks that must be used.

In some localities, some railroads have already adopted the use of high-



The Three-Ton Truck, with "Stake Body" and Removable Canvas Top, Satisfies the Requirements of Many Bridge and Building Gangs

way vehicles for transporting bridge and building gangs, and, apparently, with gratifying results. In addition to the ability to operate at greater speeds on the streets and highways than on the rails, there are not the delays incident to clearing for trains and yard movements, or due often to finding tracks blocked with standing trains or cars. According to the distance from headquarters that can be traveled to advantage by highway conveyances, it has been possible to reduce or eliminate the use of outfit cars for the use of gangs being dispatched to their points of work.

Increased Flexibility

There is unlimited flexibility in the use of highway vehicles, permitting the sending of just the right number and kind of men to handle a job, whereas a crew in outfit cars is normally fixed in number as well as with classification of individuals. This latter situation results all too frequently in there being fewer men on certain specific jobs than are needed to handle the work properly, including flagging, while in other cases there are too many men for the jobs at hand, such as adjusting stock yard gates or fixing a coal bin. Furthermore, the cost of the work is often penalized by the necessity of using mechanics to do laborers' work—for example, a carpenter crew excavating, or placing or readjusting rip-rap.

Hand in hand with the transporting of men is placing within their convenient reach the materials and tools they must use, and having them there at the right time—not too late, neither too far in advance, lest there be loss by theft or the station warehouse be cluttered with aging company property. The material should remain with the storekeeper as long as possible, not only for its protection, but to minimize the stock investment. Special tools and equipment should be kept at central headquarters for dispatching only as needed, thus permitting greater utility by being able to care for the needs of more crews. The highway truck has demonstrated its practical usefulness to such ends.

Type of Highway Vehicle

As in the case of much roadway machinery developed for use on or off track, the highway conveyance immediately presents obvious advantages. However, as with roadway machines, the true test as to its economy rests with the ability to keep it gainfully employed. This demands definite and daily supervision on the part of someone, after a study of local conditions and requirements has determined the kind of vehicle or vehicles that will best meet the needs of the district, and what departments and crews will be serviced by them.

In consideration of the foregoing, it appears that a highway vehicle is needed which can be used for transporting men and some materials simultaneously, and be adaptable readily to the handling of bulky and heavy materials alone—yes, even small buildings, such as flagmen's cabins. These requirements are satisfied to a quite satisfactory extent in the "stake body" truck of three tons capacity, sheathed on both sides of the stakes and covered with removable bows and canvas. The body, 7 ft. wide and 16 ft. 6 in. long, is provided with plank seats, designed for convenient folding or entire removal when the space is needed for handling material. There are other special features possible in this type of truck, such as tool boxes, a compartment under the body for handling safety cans of gasoline, a tail gate and suitable rear view windows. This description of one type of conveyance is brief, if not vague, and is offered only to suggest the possibilities of design which will result in maximum efficiency, considering the investment.

At the present time, many railroad officers are concerned with the question, "Can I increase the efficiency of certain maintenance of way men and, after all costs are figured, show a real and substantial reduction in expenses by utilizing the highways? If so, what is the procedure?" The answer to the first question can, no doubt, be determined best by obtaining figures from those who have undertaken such operation. The answer to the second question, in part at least, might be based on an actual trial, utilizing the suggestion offered herein with regard to the type of truck.

At the larger terminals, suitable trucks will definitely expedite the movement of bridge and building gangs to and from work, and will readily permit the distribution of the different members of the gangs so that all may be employed advantageously on necessary work. Furthermore, they will insure keeping these men supplied with the material they need direct from the store room or headquarters, thus eliminating the possibility of its theft, going astray, or being stored in some building where, perhaps, it may be forgotten. In addition, they will make possible the immediate and proper disposition of material removed or left over upon the completion of the job. One truck can readily handle and supply several crews within a limited radius, and also have time in which, under proper supervision, to serve the needs of other departments. One of these departments is the track department, the gangs of which, with motor and push cars handling small track material, welders' gas cylinders, etc., often have difficulty in getting through a congested area to a job, and then returning the released scrap and usable material to a proper place before some one, who can afford a truck, steals and carries it away, or some boy, who does not realize the probable consequence, places a spike or other small piece of metal on the rail.

On-Line Jobs

Beyond the terminals, larger cities and yards, the situation with regard to the use of highway trucks is different, possibly to the extent that general use of the highway by bridge and building gangs is questionable from the standpoint of economy. However, it is thought that, in all probability, the instances in which highway usage will not pay will prove to be exceptions, and relatively few. Good highways provide ready access to practically all miscellaneous buildings, including water and fuel stations. Many bridges can also be reached by them, although not all.

If there is no road near a bridge, access to it may be obtained, with permission, through a field. Failing in this, in some instances, the truck may serve advantageously to reach the point of highway-railroad contact nearest the bridge, from which point a track car, or cars, as necessary, may be used to reach the bridge. Generally, such limitations will be few and encountered infrequently on any district that would be selected for serving by means of highway vehicles.

Under proper planning, bridge work at locations inaccessible by good highways can be completed during the warmer weather, and any ordinary winter work confined to bridges that are easily reached—preferably those nearest headquarters. Winter conditions in the colder states, especially those subjected to much snow, create many emergencies for bridge and

Track Motor Cars Are Operated with Difficulty in Many Territories, but Still Have a Place Where They Can Be Used to Advantage

building and water service forces. Building emergencies are confined largely to terminal facilities, such as enginehouses, turntables, coaling stations and similar important operating facilities, while emergency bridge work is relatively small. Streets and highways are usually kept open during snow storms or are made available soon thereafter, so that forces can be dispatched by truck or automobile with little or no delay. On the other hand, it may be impossible to operate track cars at all under such conditions or such operations may be slow, unusually hazardous and, not to be overlooked, they may be a cause of extreme discomfort and fatigue to the men.

In a specific length of time, crews can move a far greater distance in trucks or automobiles than on track cars. Delays are minimized on the highway, while they are uncertain and difficult to foresee in rail traffic; hence, in trucks or autos, crews can be transported to and from working points located far beyond the limitations governing track car operation. Outfit cars, perhaps, cannot be eliminated entirely, but surely there is opportunity to reduce their use greatly. An arrangement whereby bridge and building men can reach their homes at the close of the day is of mutual advantage to them and to the railroad.

Trucks for Water Service Work

Water service forces can take advantage of the highways even more readily than can bridge and building gangs, because invariably their points of work are reached by highways—more often than not, improved ones. Furthermore, in the majority of cases, only a small crew is involved, frequently only one man; the work is largely "trouble shooting," and a light truck is ideal for their use, either in quickly taking care of an emergency situation or in their daily routine. Some railroads have provided all or part of their water service forces with suitable highway conveyances and report highly satisfactory results. In many instances, individuals use their own automobiles with or without an allowance, but in the latter case, it appears that the benefit accrues mainly to the employee through his ability to reach his home more frequently or readily than would be possible otherwise, rather than in an extension of territory to effect a saving for the railroad.

Several major items must be considered when comparing rail and highway transportation of maintenance forces. Among these are the investment in and upkeep of the equipment, and the element of safety. With respect to the latter, the highway vehicle seems to offer some advantage. Highway vehicles must be inspected frequently, with regularity and thoroughness, and must be kept properly serviced and in good repair to insure safe operation, as well as to prevent costly delays. This demands that the driver be selected with proper consideration to these matters, and that he be trained to utilize a part of the time that his truck is necessarily idle to make minor repairs and adjustments. Insurance and license costs must not be overlooked.

The deliberations of your committee have revealed many ways in which it is felt that highway vehicles can be utilized to increase efficiency in railroad maintenance work and permit the showing of decided reductions in maintenance costs. We believe that the gradual expansion of the use of such vehicles under intensive study and proper supervision will unfold new and practical advantages, almost unlimited.

The power unit in a truck is, in itself, a potential maintenance tool if harnessed suitably; it can be adapted to the operation of power tools and can be used for hoisting and skidding. A dump truck has its place in some localities, although, because of poor riding qualities and its general construction, it is not entirely suitable for transporting men, except over short distances. Here, rental may well pay when investment would not. The use of trailer camps in conjunction with highway conveyances, especially in more remote locations, offers some possibilities. A light truck or automobile in the hands of a general foreman permits him to expedite his inspections and contact with scattered jobs under his jurisdiction.

Conclusions

In conclusion, the results of the study of this subject by the committee may be summarized as follows:

(1) The track motor car provides the natural means for transporting men and lighter materials by rail over relatively short distances. It requires, however, that outfit cars be used extensively.

(2) Until more recent years, outfit cars and track cars were the only means available for housing and feeding men, and for moving them to and from their work. We now have improved highways, which present an opportunity to transport men, tools and the lighter materials by truck, greater distances, and in less time than is possible with track cars.

(3) Changes in train operation have placed upon the maintenance forces the burden of determining the most efficient and economical means of transporting men and material to and from points of work.

(4) The use of the highways permits the concentration of forces at the larger terminals and headquarters, thereby enabling the supervisor to assign men to various jobs more advantageously from day to day, and to use to better advantage the tools and equipment at his disposal. Suitable highway conveyances make it possible to expedite the special rush jobs, large or small, and to take care of emergencies at distant points, near which no crew may be located.

(5) The handling of material by truck makes it possible to maintain smaller stocks, prevents loss and theft, and insures delivery at the time needed.

(6) The elimination of or reduction

in the number of outfit car units relieves the operating department of costly interference with train operation. Handling material by truck may frequently obviate expensive work-train service.

(7) Light trucks or automobiles permit greater efficiency on the part of water service employees and others, including general foremen and supervisors.

(8) Close supervision of highway vehicles will result in valuable assistance in many ways, not only to those in the maintenance of way department, but to others as well.

DISCUSSION

President Church: We have had a very interesting report and we should take advantage of this opportunity now for a constructive discussion from the floor. Are there questions anyone would like answered?

J. P. Hanley (I. C.): Mr. President, Mr. Long's report is very timely, and I believe it comes under the same category as welding—it is a modern development now come into active use. I believe the use of trucks will greatly increase in the future. On the Illinois Central we now have about eight trucks for water service work—of the half-ton type. They have greatly increased the efficiency with which the men get to their points of work and of transporting light loads, which were formerly moved on local freight trains or motor cars. The truck gets the men to their work and back without so much travel time.

Some years ago I was on a committee of the American Railway Engineering Association which had this subject under consideration. Even at that time we found some roads making extensive use of trucks. For example, the New York, New Haven & Hartford, running through such a highly congested territory, doesn't want motor cars on its tracks. At the same time, on isolated divisions where there are few trains, a truck is also desired to get to and from points of work readily. So, I believe the subject of truck transportation is a live one and that the use of trucks will increase.

Practice on Roads Varies

Chairman Long: Mr. Gillis of the New Haven is vice-chairman of this committee and contributed some very valuable parts of this report; very much of the report, in fact. We have mentioned only the New Haven, but I believe a number of the other railroads in the East have pretty well motorized their bridge and building forces.

President Church: I would like Mr. Varker to speak for the Delaware & Hudson.

J. L. Varker (D. & H.): We do not have any trucks in our department. The stores department has one truck which is used at various times by both the bridge and building and track departments. We are trying to get trucks in the bridge and building department, and, eventually, I think we shall. There is no question but that there are cases where trucks can be used to great advantage, particularly in locations where the gangs have to travel short distances or where considerable delay is caused by train operation. Eventually, I feel certain, motor cars will be largely replaced by trucks.

Armstrong Chinn (Alton): I think Mr. Long has covered the subject very thoroughly and has given us much to think about. We have heard several speakers and committee chairmen tell us how we must conserve materials. I think we are going to have to do the same thing with man-power, because, under present conditions, it is certain to be almost as difficult to secure men as it is to get material. One way to conserve man-power is to get more productive hours from your men, and one way to do that is to get them to the job and back to their camps or homes with the least delay. It seems to me that, under present conditions, trucks offer a solution to the problem in many cases, particularly in the water service department.

There is a branch line on my railroad where, if we have a breakdown at any water station and send a water service man from headquarters by train, he must be gone two days, even if the job will require only two hours of his time. If he had a truck, he could get from headquarters to the job and back in four to five hours.

Rents Trucks

K. L. Miner (N. Y. C.): I do not have any trucks under my jurisdiction, but we do rent trucks when required. We are able to rent most any type of truck we want for transporting men and materials. We can rent from one to four trucks on the same day or in the same hour, if necessary. Of course, there are days when we don't use any trucks. The expense for a Drive-Yourself truck is 50 cents an hour, whether it is standing or running, and 6 cents a mile for the miles actually driven. I feel that under this arrangement we have great flexibility, because we can get the type of truck we want and directly at the location where we want it. My headquarters are at Albany, N. Y., and if I want a truck there, or at Rensselaer, Troy or Schenectady, I can get the type needed in any one of those cities at the rate already stated.

Mr. Chinn: How do you make those arrangements, Mr. Miner? Is it all one company that you rent from?

Mr. Miner: Yes, the Drive-Yourself Truck Company, which, with its various services, is located throughout what we call the Capital district.

Mr. Chinn: How did you sell that idea to your management?

Joint Use

B. F. Francis (N. Y. C.): Mr. President, this subject of truck transportation is one I think that all the railroads are going to get into to some extent in the future. We have three 1½-ton GMC trucks on my division, one coming directly under the supervisor of bridges and buildings, and one on either end of the division, coming under the supervisor of track. We work together in the use of those trucks. The maintenance of the trucks is taken care of by the shop forces of either the maintenance of way or the bridge and building department. We have found these trucks great labor-savers in getting the men to and from their work. We also avoid a great deal of overtime and would be very much handicapped if we should lose the services of those trucks. It would be a real problem to get our men out by train under the present operating conditions—we have no passenger trains on my division, and all motor cars are operated by train order. It is almost impossible to get over the road with a motor car to undertake any work outside of the headquarters district. It seems to me that motor trucks are answering the question of getting our men to and from their work, and at the least expense.

G. S. Crites (B. & O.) : Mr. Chinn emphasized the need for conserving materials and man-power; Mr. Miner has told us of renting trucks; and now Mr. Francis has covered the subject of maintenance of way trucks, where they are coordinated between the track and bridge and building departments.

If we go into truck service, as is justified, the need will arise for conserving this service. Trucking corporations keep closely in touch with their trucks and dispatch them rapidly and with very little loss of time. In the larger terminals, we shall probably resort to dispatching trucks from one central point for all departments. In this way, a marked saving can be made in the operation of trucks.

W. A. Huckstep (M. P.): Mr. President, trucks have their place in the general developments of our expanding transportation facilities. However, I feel that they should find their place through economic processes rather than "pork barrel" politics.

We use trucks where economies can be shown; but with a public not as yet fully informed with respect to all elements of cost involved in the different types of transportation, we have, to some extent at least, kept away from advertising our own railroad on these vehicles.

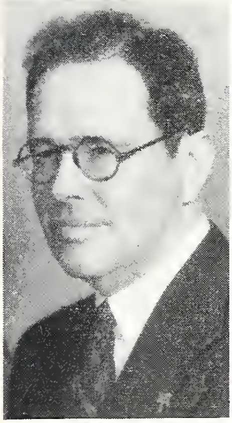
We have a number of trucks in the various divisions of our maintenance of way department, which are used chiefly around large terminals. Some employees are authorized to use their private automobiles in railroad service, but this practice is not encouraged. Such cars are then included under our fleet insurance. No person is permitted to use his private automobile to go to or from any point on the railroad in the performance of his duties unless such use has been authorized. The reason for this is that there have been instances of accidents to persons using their automobiles on duty, while not covered by insurance. I recall one such case which resulted in a personal injury entirely away from the railway property, where the railroad was not protected by insurance. So, if any of your men are using their own cars, I suggest that protection for the railroad be looked into.

President Church: We have had some very interesting comments on this report, and I am sorry time will not permit a continuation of this discussion. Mr. Long, we greatly appreciate your efforts and those of your committee in preparing this fine report, and for presenting it in such an able manner.

Modernizing Water Facilities to Meet the Demands of Modern Train Operation

By A. B. Pierce
Engineer Water Supply
Southern, Washington, D. C.

(Introduced by President Church)



A. B. Pierce

President Church: No railway facility is more essential to smooth and efficient railway operation than the modern water station. It is not enough that the supply be adequate in quantity. Neither is it enough that it be of the proper quality. In these days of rigid economy, water stations must be efficient in design and in operation in order that the costs of providing an adequate quantity of water of the proper quality will be at the minimum. Railway water stations have undergone revolutionary changes in recent years until the station of today resembles its forerunner of a generation ago in few respects.

One of the railways that has been most alert in recognizing and in utilizing these developments has been the Southern. It has rebuilt many of its stations. It plans to rebuild others. The man who has led in this development is its engineer of water supply, A. B. Pierce, who is going to speak to us out of his experience, on Modernizing Water Facilities to Meet Modern Operating Conditions. Mr. Pierce.

Address

The modernization of water service facilities to meet today's operating conditions has been given active and favorable consideration by many railroads during the last few years—resulting in substantial savings with relatively small cash outlays. Economy in railway operation has been the slogan. The many different steps taken by the railroads to reduce their operating costs have brought about marked changes and improvements in water supply facilities.

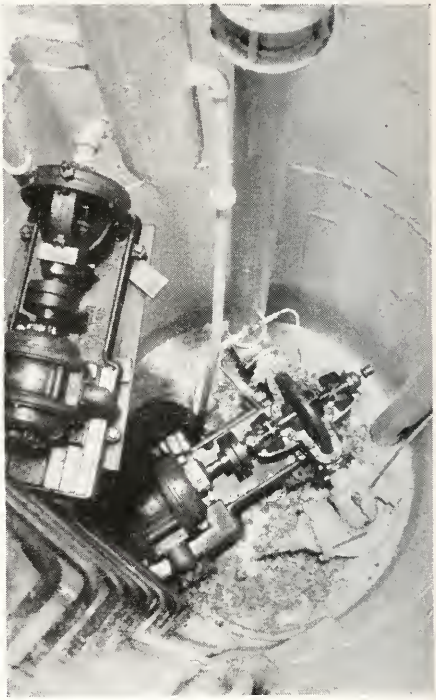
To compete with passenger automobiles, trucks and buses, speed in passenger and freight service has been essential and demanded. Locomotives have been double-headed, tender tanks increased in capacity, schedules speeded up and water station stops eliminated. At the same time, something had to be done to our old water stations, forgotten while these radical changes were coming about.

Merely to put on another pumper has not been the solution, as we cannot ignore the economy in operation that is desired. Storage tanks have had to be increased to meet the demands due to the reduction in the number of water stations. To help reduce the time required for taking water, larger water columns and supply lines have had to be installed; larger pumps have been required.

Types of Pumping Units

A number of improved types of pumping equipment are being used to replace the old steam pump. Where coal or electricity is not available economically, an oil engine may be used to operate a deep well turbine pump or a horizontal power or centrifugal pump. These oil engine units are fitted with electric starters similar to those used on automobile engines, and may be operated automatically. The starter is energized by a pilot circuit which consists of either a tank float or a pressure switch on the discharge line. Suitable relays and magnetic switches are installed to provide protection against failures of lubrication, fuel oil or cooling water. Low grade oil may be used with these engines.

In addition, we now have available close-coupled centrifugal pumps, with the impeller applied to the extended motor shaft. This is a most dependable type of pump and can be installed in any position; it may even be hung on a chain, if desired, in a shallow well. This type of motor-driven pump is adapted particularly to automatic control with either a tank float or pressure switch. A foot valve is required with some form of automatic priming device. If the pump is installed with a suction lift, a ¾-in. bypass pipe from the discharge line to the suction pipe will keep the pump and suction filled with water.



A Close-Coupled Centrifugal Pump Installed in a Waterproof Pump Pit

If not too expensive, this type of pump, for most dependable operation, should be installed without a suction lift—in a waterproof pump pit. This requires an automatic sump pump. Such a pump may be installed in the existing pump house with a 12-ft. suction line running to a suction well, and with the water flowing from the source of supply to the well.

An automatic motor-driven power pump may be used which does not require a foot valve or priming device. This unit is more expensive in first cost and requires more maintenance, but has advantages in handling high suction lifts.

The turbine-type deep well pump is the most dependable and economical pump for automatic service. This type of pump may be installed in an existing suction well, with a small pump house. It does not require a priming device, a foot valve or a waterproof pit with necessary sump pump. Another important consideration is that the pump is always below low water, without a suction lift. Furthermore, the motor is above the pump pit where it is available for ready inspection. An "A" frame tower is generally installed over the pump house for convenient withdrawal of the pump for repair. As now built, these pumps give high efficiency.

Some roads have installed this type of pump with the motor in the well, below the pump and always covered with water. Such a pump is known as a submersible-type turbine deep-well pump. Where extreme rise and fall of water are encountered and it is difficult to install a motor above high water, this type of pump may be used to good advantage. It does not require a pump shaft, which reduces friction loss in the column pipe and eliminates shaft bearing troubles. However, it does require a power cable and an oil line through the well to the motor. A mercury seal is used to prevent water from entering the motor. The motor, pump and power and oil lines all have to be removed for inspection and repair. There is a difference of opinion as to the dependability of this type of pump for automatic operation, without an attendant.

It is not to be expected that any type of automatic pumping equipment, without a pumper, can go without periodic inspection. Such inspection may be placed in the hands of the local track and signal inspectors and the division pump repairmen. All of the electrical equipment can be tested, generally, by the signal department men, and the pumps, piping and tanks can generally be looked after by the track forces. Any repairs found necessary should be reported by telephone, and steps taken immediately by the pump repairman or electrician to put the equipment in proper operating condition.

It is the duty of the pump repairman to test the pumps periodically and to give them general overhauling as necessary, including attention to lubrication and the maintenance of clean suction wells. Pump repairmen should report all necessary electrical repairs to the division electrician. Repair parts should be carried for large or important pumping stations. All automatic terminal pumping stations and stations with chemical treating plants should have full or part-time attendants.

Automatic pumping stations without an attendant should be heated to prevent freezing. Small electric heaters are available for this purpose, which do not involve much expense for current if the pump house is well insulated. In some locations, an electric light, plus the heat from the motor, prevent freezing.

With the enlargement of locomotive tender tanks, it has become necessary to install larger water storage tanks. To give dependable service, at least 24-hr. storage should be furnished. Present-day larger tender tanks have made it possible to retire many water stations, which, automatically, made it necessary to enlarge the storage tanks on either side of the stations abandoned.

Still, this has not solved the problem of speed in watering locomotives. With larger tender tanks and a reduction in the number of watering points, it has become necessary to deliver water at a greater rate, if train schedules are to be shortened. As a result, it has become necessary to enlarge water columns and water column supply lines, and, in many cases, to elevate storage tanks.

Years ago, a delivery rate of 1,000 gal. per min. for 7,000-gal. tender tanks was ample. Today, a delivery rate of 4,000 to 5,000 gal. per min. is required to keep step with the whole program of speed. As a result, 12-in. telescopic columns are used with 12-in. and 14-in. supply lines in place of 8-in. and 10-in. columns and 8-in. and 10-in. supply lines. These changes, of course, have been necessary largely on main lines, 10-in. columns with 10-in. supply lines still being generally satisfactory on branch lines.

Retirement of Water Facilities

Where electric pumping units are installed, it is advisable to retain the existing steam or oil engine units as stand-bys for emergency operation in case of current failure. These existing units should be kept in good operating condition. To be sure that the old units are available at all times, quarterly reports should be made, indicating the date the old units were actually operated, their condition at the time of test, and all repairs made. The old steam or oil engine units cannot be relied on in an emergency unless they are put in full operation periodically.

The retirement of water stations should be given careful consideration. It is rather dangerous to abandon a source of water supply, tanks, pipe lines and pumping equipment until, through actual operation, it is known definitely that this step can be taken. While the Southern has retired more than 60 water stations in the last few years, this has not been done without careful study of operating conditions in each case.

When considering the abandonment of a station, we first determined whether the adjacent stations would furnish the additional water requirements through all seasons of the year. If it was found that they would, the plant was taken out of service temporarily, but the facility was not abandoned until it was proved definitely that the station was not required, even for emergency, through actual operation of the new arrangement.

Large Savings

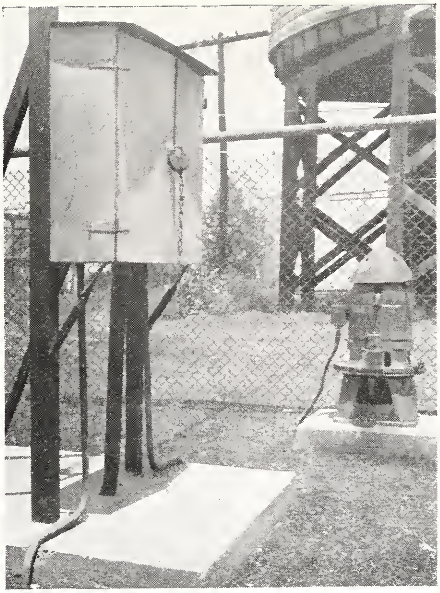
During the last six years we have been given special appropriations for carrying on an extensive program to eliminate old steam plants requiring from one to three pumpers. We now have more than 80 fully-automatic, motor-driven water stations. Sixty of these stations cost a total of $110,000, and have effected actual annual net savings of $78,000, or 70 per cent on the total investment.

At one station alone, where a deep well installation was made, eliminating the purchase of city water at 12 cents per 1,000 gal., the annual saving resulting amounts to $9,800. This saving is not an intangible figure, but is based on former water bills, compared with the actual cost to operate the deep well plant, including inspection, current, maintenance, depreciation, and interest on the total investment in the new facilities of $9,500. This represents a return on the investment of more than 100 per cent. This station has a well 610 ft. deep, a 30-hp. motor, and a 300-gal. per min. turbine pump, with automatic control. At other stations, using close-coupled centrifugal pumps costing from $1,300 to $3,500 each, we have effected annual savings of 40 to 80 per cent.

A survey of the water stations on the Southern showed clearly that all steam pumping stations could not be converted to automatic stations with savings. Some had to have an attendant to look after the source of supply, which was not dependable; at other locations, current was not available or was too expensive. Also where two or three small steam plants were taken care of by one pumper, we found that it would not pay to install automatic pumping plants.

Water for Diesel Trains

As a water supply engineer, I cannot agree with the statement found in one of the railway magazines recently that if the use of Diesel locomotives continues at the present rate, "the days of the water station will be numbered." In the first place, an exceptionally good quality of water is required for cooling Diesel engines; secondly, air-conditioning requires about three times as many watering points as oil fueling locations.



Turbine-Type Deep Well Pumps, As Now Built, Have High Efficiency

The water used for air conditioning has to be of a far better quality than for steam locomotives and requires special cleaning pressure pumps and special treatment. Diesel engines carry tanks of only 1200 and 1600 gal. capacity, which have to be filled every 300 or 400 miles. Furthermore, these tanks have to be filled at a high rate of delivery, as most Diesel passenger trains have fast schedules and are only allowed four or five minutes for servicing. On the whole, we have done a good job of modernizing water facilities to meet today's railway operation. With a large reduction in the number of water stations, the enlargement of water columns and storage tanks, the automatic operation of efficient pumps, and improvements in water treatment, we have kept pace with the demands for speed and economy. Water is now being delivered at the rate demanded, of the quality required, and at a lower cost than at any previous period in railway history.

DISCUSSION

President Church: Mr. Pierce, you have certainly made a splendid contribution to the subject of modernizing water stations and its effect on the railways in reducing operating expenses, carrying charges, etc. It should bring out a very interesting discussion.

C. R. Knowles (I. C.) : Mr. President, I have listened with great interest to Mr. Pierce's excellent address. In discussing the subject with me prior to this meeting, Mr. Pierce was afraid he wouldn't be able to offer anything new, but I think he has given us many new thoughts. Not only that, he has presented an excellent summary of things we, perhaps, already know, and it is a good thing once in a while to be thus reminded.

Mr. Pierce mentioned the use of deep-well turbines, particularly of the submersible type. I have given much study to the use of this type of turbine and have come to the conclusion that it is chiefly adapted to very deep settings. Fortunately, on the Illinois Central, we have water at a reasonable distance from the surface, which makes it possible to use relatively short line shafts on our pumps. For this reason, we haven't used the submersible type pump as yet.

Mr. Pierce questioned the likelihood of water service men losing out because of the increasing use of Diesel engines, and I quite agree with him. For example, a seven-car Diesel train, requires eight different water connections. Mr. Pierce mentioned a time of four to five minutes for taking on water and fuel. We allow only three minutes.

Usually, the water and fuel connections to a Diesel locomotive are two inch in size. There are also 1½-in. water connections to both the locomotive and the cars. As Mr. Pierce has said, the tanks on the Diesel engine range from 1200 to 1600 gal. capacity, and for each stop of the power unit, about 800 or 900 gal. of water are taken on. A smaller quantity is taken on at each of these stops for drinking purposes. Then, there is also the service water that must be supplied to each coach and the diner. All of this water must be taken on the train within a period of three minutes. The consumption, of course, will vary with the season.

I think it is generally agreed that, for heating purposes during the winter months, each coach will require 25 gal. of water an hour, and possibly an equal amount for air conditioning. Therefore, instead of having one water connection to make with each train stop, there are from 7 to perhaps 10, depending on the number of units in the train. I believe I am safe in saying that if all motive power on the railroads of the United States were Dieselized, it would not be a case of dispensing with our present water service men, but rather one of increasing our water service forces.

Mr. Pierce: I wouldn't go quite that far, but I am glad to hear you say that you agree with me that there will still be a place for water service men.

Take Out Old Units

Mr. Knowles: Mr. Pierce also said that where an automatic electric installation is made, the old unit, whether steam or oil, should be reserved as a standby unit. I agree that that should be done in all cases of important stations operating with only one electrical unit. However, power supplies are so dependable today over most of the country that I think the same result may be secured by installing a duplicate electrical unit. These electric units don't cost a great deal. The expense for installing an additional unit will probably amount to only 15 to 20 per cent of the total installation cost, depending on the type of installation.

Mr. Pierce: Mr. Knowles, it is my thought we should leave in the old plant, whether steam or oil, regardless of how many electric motor-driven pumps there may be, because otherwise, if the electric current fails, there wouldn't be any means of pumping water. The idea is that if you have an oil engine or a steam pump as a standby, you can still operate it if the motor fails or the electric current goes off.

Mr. Knowles: To a certain extent you are quite correct, Mr. Pierce. Where there is any possibility of an interruption to the service, I quite agree with you; but I have in mind certain locations, particularly throughout Illinois, where we are supplied with electricity from several different sources. For example, we have water stations which are served with power from the Keokuk dam, from the Sanitary District plant, from the Big Muddy power station of the C. I. P. S. Co., from the Grand Tower power station, and from both the Dix dam and the Earlington plants of the Kentucky Utilities. Now that may seem rather odd, but these power systems are all inter-connected, and a power interruption on any one of them is never more than temporary—just long enough to throw a switch and cut in another source of supply.

Never Use Old Units

J. P. Hanley (I. C.): Some time back we installed an electric pump in a steam-operated pumping station at Rockport, Ky. It was at first planned that the steam equipment, consisting of a 45-hp. boiler and a 12 by 8 by 12 pump, would be removed when the electric pump was put in. However, at this point the current is not the most reliable and, finally, caution prevailed and the steam pump was allowed to remain. That pump stayed in for 10 years and it was never operated. When we took it out, it was in such poor condition that it was never used again.

We had the same situation at Coleman, Ill., about 40 miles west of Chicago. The steam pump here was also kept in position, ready for use, but after eight or nine years we removed it because it was never used.

My experience has been that even if the current does go off at a plant, it is usually restored before we could possibly get the old steam unit in operation. It is just human nature to more or less neglect these old steam units, and if this is permitted, you might want to call on one of them in a hurry and find the suction valve filled with sediment, or the pump rusted, or maybe the boilers in need of attention. Therefore, I believe that in most cases where dependable electrical sources are available, it will be perfectly safe to remove the old steam equipment when the electric pumps are placed in service.

Safeguard in Old Units

Mr. Pierce: I am perfectly willing for you to take out your old steam pumps. However, we have five different places on the Southern where we would probably run out of water if we didn't keep the old steam pumps and boilers in, ready for service. As to letting the steam pump and boiler deteriorate, that is one of the points I tried to bring out in my paper. You can't expect to use the old steam unit unless it is kept in condition and put into full operation periodically, and a written report made to this effect. Unless you do this, you might as well take the old equipment out.

Mr. Hanley: I think that depends a good deal, Mr. Pierce, on the location of your electrical installation. I agree with you that there are places in the South where electrical distribution systems are not up to date. With the extension of TVA and the REA distribution systems, however, they may have a wider distribution of dependable current in that area before long.

C. R. Knowles: I want to make myself clear on this point, Mr. Pierce. I didn't intend to take issue with you, because where there is any possibility, even a remote possibility, of power failure, I think, by all means, a stand-by unit should be maintained.

Mr. Hanley referred to the extension of REA power. Power from that source, which is single-phase, is not at all dependable for pumping service, except with very small motors. I doubt if you can find any electrical authority who would agree to placing on this REA current a motor in excess of three horsepower. The use of this REA service requires a very expensive installation, costing, perhaps, for equipment and maintenance, twice that for units in three-phase service; and I say again, it is not at all reliable.

Many Automatic Units

Mr. Pierce: Within the last couple of years we have installed about 15 fuel oil stations on the Southern for Diesel engines. They have been operating very satisfactorily and I thought the subject was past history. However, just before I came here, I received a letter from the mechanical department asking that we put in a gas engine fuel pump at each of these stations so that if the motor-driven fuel pump fails, fuel oil can still be delivered to the Diesel engines. This is the same principle that we apply to our water stations, and I think this extra power is a good thing. We have steam plants that we have never used, but where we have needed and used them, we have saved money.

Mr. Knowles: I neglected to comment on Mr. Pierce's statement that his railroad has 80 electrically-operated pumping units.

Mr. Pierce: More than 80.

Mr. Knowles: We have 60 electrically-driven surface units and 44 deep-well units on the Illinois Central, all automatic in operation. They are pumping 2,700,000,000 gal. of water annually. I may say, however, that two of the units are booster pumps, one in Chicago and one in Centralia, Ill., both of which pump more than a billion gallons of water annually.

Increasing Supplies

Mr. Crites (B. & O.): We are greatly indebted to Mr. Pierce for his address and have been greatly enlightened by the discussion that has taken place. I conclude from what has been said that there is an ample supply of water along the Southern Railway.

Mr. Pierce: We have several places where our source of supply is not ample, but, generally speaking, we are fortunate with our water supply sources. We pump from creeks and streams, and in the summer months, many of them dry up. In Virginia, we are having considerable trouble at the present time. At Mt. Vernon, we have been hauling water for several years. So we do have troubles in that way.

Mr. Crites: Those conditions of which you speak prevail rather generally through the Southwest. I am wondering if there could be some discussion on augmenting the supply at the source by improving and deepening wells, making studies of the water strata, etc.

Mr. Knowles: In that connection, I think it is true that during the last two or three years droughts have been pretty general over the country. They have been rather scattered, but general through the South, and particularly through Southern Illinois. We have had a prolonged drought through Central Illinois, from Mattoon to the Ohio river, where the rainfall has been only from 40 to 50 per cent of normal. To the end of August, at Carbondale, which is a rain gauging station, the rainfall was only 12 in., as compared with a normal of 25 in., and city reservoirs in that territory haven't been filled for three years. As Mr. Pierce has said, Mt. Vernon has been out of water for two or three years. We are now hauling water to Centralia, Ill., one of our large terminals. We haul trains of 60-tank cars daily, with nearly 500,000 gal. of water. We have had to put in an emergency station on the Big Muddy river to supply our station at Carbondale. Incidentally, that is an electrically-driven emergency station, and it is automatic in operation.

The increasing of water supplies, particularly from deep wells, has been an interesting task with us. Lately, we have been experimenting in the re-development of some of our deep wells. At Champaign, Ill., we have a number of such wells, ranging from 170 to 190 ft. deep, including some old 10-in. wells drilled in 1903 and fitted with ordinary fine screens. We decided to experiment with gravel packing these wells. I think you will agree it was a rather risky experiment to go into and gravel pack a well 38 years old. However, we finished one of them day before yseterday. Mr. Hanley, who was down there, just gave me a report that as the result of the work done, the capacity of the well was increased to 230 gal. per min. at the surface and 180 gal. per min. into the tank. That is an increase from 70 gal. per min. at the surface, and indicates what can be done with some of these old wells.

Mr. Pierce: We have drilled several wells to augment present supplies. Just last week I obtained authority to drill a well to augment a supply coming from springs which are drying up and giving us trouble every year. We hope to be able to take care of any deficiencies at this point from the deep well planned.

In Oil Country

Mr. Crites: Where geological data are available, such data may be of aid in determining the probable source and quantity of ground water to be found in a specific location, but, unfortunately, such data as are available are usually based on insufficient observations from wells or other borings. Of course, in the Southwest and many other sections of the country where they now have deep oil wells, it is possible to get a better picture of the water-bearing sand and its characteristics. I have been wondering what use has been made of the added information available in this oil well territory to augment water supplies at their source.

Mr. Pierce: When we decide to drill a well, we first go to the Agricultural department and secure all the information we can from it. We then talk to all the well drillers in the particular locality where we want the well. Then, regardless of the information we have secured, we pay a well driller to make a test well, because we never know whether we are going to get water or not.

Mr. Knowles: As a rule, I think you will find any water in oil-bearing territory unsatisfactory for boiler use.

There are certain sections of the country where the geological survey data give accurate information. For example, in the territory extending from Anna, Ill. to Paducah, Ky., and down to Jackson, Tenn., the geological data are very satisfactory. In the territory outlined, and on down through to the Gulf, one need have no fear whatever of obtaining an ample supply of water. In many cases the pressure will be sufficient to force the water into the tanks without pumps; and the water will be of excellent quality—as good as the water that Mr. Pierce brags about on the Southern.

A Member: Mr. President, I think we are greatly indebted to Mr. Pierce for telling us of the many improvements that have been made in railway water service. His address will, undoubtedly, be an inspiration to all of us to look over our own water plants and to bring them up to date. In listening to this address, however, the thought occurred to me that we no sooner get one problem licked than we are faced with another. This modernization of our water stations presents another problem. For instance, 20 years ago on one of our divisions we had 34 pumpers; now we have 2. If we didn't require water treatment, we probably wouldn't have these two.

Now, you men who have been on the railroads for a long time know as well as I do that it has been the policy on most roads to take care of their old bridge and building men by giving them jobs as pumpers or crossing watchmen. Through the elimination of crossings, we need less crossing watchmen, and, as Mr. Pierce has stated, we are now doing away with the steam plants and the pumpers. It occurs to me that we may be facing a serious problem as to how to take care of our old bridge and building men in the future.

Mr. Knowles: The Railroad Retirement act will take care of a great many of these old timers.

In Texas and Louisiana

R. E. Caudle (M. P.): As to the possibilities of water in the oil fields—I am located in Texas and Louisiana and I think the trouble with the water in the oil fields is that it contains too much salt to be suitable for boiler purposes. All of the water we use in the oil fields is from shallow strata. There might be a strata 400 ft. down that contains water fairly good for boiler purposes, but 500 ft. down the strata might contain 700 or 800 grains of salt. Some of our worst water conditions are encountered in the oil fields where we need water the most. We haven't been able to get any information from the oil well people that would assist us in any way in getting good water in that area.

Mr. Knowles: We would be satisfied if the oil people would keep the salt in their wells. Our principal difficulty in the oil fields is that they discharge salt from their wells into the streams, and sometimes into the reservoirs, with the result that the water is badly polluted. I think Mr. Pierce can tell us something about that. He has had to change a couple of water supplies because of an excess quantity of salt.

Mr. Crites: My thought was not that the oil wells are a source of supply of water, but rather that their drilling gave the United States Geological Survey much information on the strata penetrated.

Mr. Caudle: The only information we get in that respect is the location of the different water strata. We get nothing on the quality of the water. In 1931 and 1932, when the East Texas oil fields were brought in, we drilled a number of emergency wells there for water to take care of our locomotives, wells that reached down to a depth of 900 ft. We obtained good water from these wells for many years, but now salt has come up through some of them and ruined them, so we have had to abandon them.

President Church: Mr. Pierce, your address on the modernization of water facilities has been very enlightening and will be helpful to all of our members. We thank you very much for it.

Mr. Pierce: Thank you, Mr. President.

Developments in Paint Removal

Report of Committee

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C. Miles Burpee
Chairman

Faced with the general revival of painting programs, after a lean decade characterized by a tremendous accummulation of deferred painting, maintenance, the adequate removal of old films, the proper cleaning and preparation of surfaces as well as the application of suitable protective coatings are now of the utmost importance to maintenance officers. Consistent with the time which is available on this occasion, it is the object of this report to present a general summary of the methods, equipment and tools which are now available for the removal of old paint and rust films and for the preparation of the surfaces of steel structures and buildings. In an effort to present a representative summary of the current practices of American railways in this respect, this report is based upon data secured from 33 different railways, having 206,694 miles of lines or more than 70 per cent of the total line mileage of both the United States and Canada.

The outstanding developments in the cleaning and protection of steel surfaces during the last few years include the recent introduction and development of the flame-cleaning process and a marked expansion in the use of pneumatic cleaning tools as well as the use of petroleum products and compounds containing rust-inhibiting chemicals. However while the term "flame-cleaning" is in itself a descriptive nomenclature which readily classifies the process as a cleaning and dehydrating agency, the use of petroleum products involves other considerations, including protective coatings or the removal of rust or both.

Apart from flame-cleaning, and the expanded use of pneumatic tools and petroleum products as well as minor changes in tools and equipment which have increased the efficiency of pneumatic cleaning tools and sand blasting methods, no other marked changes are evident in the preparation of steel surfaces prior to repainting or recoating. The detailed descriptions of the tools, apparatus, materials and methods contained in a report entitled Cleaning Steel Bridges Preparatory to Repainting, presented at the 1935 convention of our association, still apply largely to the programs of today.

Insofar as wooden buildings are concerned, no marked difference is apparent in the methods used for paint removal and the preparation of both exterior and interior surfaces during the last five years. Except for an expanding use of torches and burning outfits, particularly those of the propane type, the detailed data, included in a report entitled The Inspection and Preparation of Wood Surfaces for Painting, which forms a part of the proceedings of this association for 1938, are still applicable in large measure to this type of work.

Hand Cleaning

While the tools and methods in general use for the hand cleaning of steel structures have not changed to any appreciable extent during the last 10 years, replies from 33 railways, representing a grand total of 206,694 miles of lines, show that 21 roads with 135,166 miles of lines, or 65 per cent of the total, now use hand cleaning methods for 50 per cent or more of their annual painting programs for steel bridges and structures. Four roads, with a combined mileage of 34,582 miles of lines, utilize hand methods almost exclusively, reporting that from 99½ to 100 per cent of their cleaning is done in this manner. Eight roads, with 69,610 miles of lines, use hand cleaning for 75 to 90 per cent of their programs, and while five others, with 13,971 miles of lines, did not state the extent to which hand cleaning is used, their replies indicate its general use; from 50 to 74 per cent of the cleaning of steel surfaces is carried on by similar means on four other railways whose combined mileage totals 17,003.

A complete summary of the extent of hand cleaning methods for steel surfaces, as reported in the 33 replies received in response to a questionnaire submitted by this committee, is presented in the following tabulation:

TABLE I—Summary of Hand Cleaning Steel Surfaces

No. of Roads	Proportion of Cleaning Programs	Miles of Line	Percentage of Total Miles of Line
4	99½% to 100%	34,582	16.7%
8	75% to 90%	69,610	33.6%
5	General use	13,971	6.8%
4	50% to 74%	17,003	8.2%
4	25% to 49%	31,729	15.5%
3	Not given	18,612	9.0%
	5% to 24%	21,187	10.2%
33		206,694	100.0%

In commenting on the cleaning of steel structures, the engineer of bridges of a large railway which employs hand cleaning methods for a large proportion of this work, states: "In most cases cleaning by means of wire brushes and scrapers is all that is required. The removal of existing firmly-attached paint is not considered necessary. When there is extensive scale to be removed, pneumatic chipping hammers facilitate the work."

Pneumatic Tools

Pneumatic tools in general use for cleaning steel surfaces consist of rotary wire brushes, chipping and scaling hammers and scaling tools. Their detailed descriptions and methods of use have already been presented to the Association and are to be found in recent issues of the Proceedings. Our survey shows that 25 railways, comprising 154,886 miles of lines, or almost 75 per cent of the total mileage reporting, are using pneumatic tools and that nine of these roads, representing 19 per cent of the total mileage reporting, are using pneumatic tools for 50 per cent or more of their steel cleaning programs. Of these, two roads, with a total of 11,643 miles of lines, reported that pneumatic tools are used for 75 to 95 per cent of their steel cleaning programs. Seven other roads, comprising 27,806 miles of lines, use pneumatic cleaning tools on 50 to 74 per cent of their work. Two roads with combined mileages of 20,737 miles of lines, representing 10 per cent of the total mileage surveyed, utilize pneumatic cleaning tools for 25 to 49 per cent of their steel cleaning work, while five others, representing almost 9 per cent of the mileage reporting, do from 5 to 24 per cent of their cleaning in the same manner.

In addition to the statistics already presented, nine other roads totaling 76,684 miles of lines reported the employment of pneumatic tools but did not specify the extent of their use. The following table presents a summary of the extent to which the reporting railways employ pneumatic tools in preparing steel structures for the reapplication of protective coatings:

TABLE II—Cleaning Steel Surfaces With Pneumatic Tools

No. of Roads	Proportion of Cleaning Programs	Miles of Line	Percentage of Total Miles of Line
2	75% to 95%	11,643	5.6%
7	50% to 74%	27,806	13.4%
2	25% to 49%	20,737	10.0%
5	5% to 24%	18,016	8.7%
9	Not given	76,684	37.0%
25		154,886	74.7%

A southern railway reports that usually when steel structures have been repainted on four successive occasions it is necessary to remove the old paint down to bare metal, and that pneumatic tools are used for that purpose. Rust is removed by pneumatic scaling tools and it is found advantageous to follow this process by cleaning the bottom of rust pits with oxy-acetylene flames. This road has also established a practice of applying a coating of fuel oil to facilitate the cleaning of rusted, horizontal surfaces, such as the tops of girders and stringers; after three or four days the rust is removed by means of pneumatic scaling tools or hand scrapers.

Another large system reports that while extensive scale is removed by pneumatic chipping hammers and that while rotary wire brushes are quite effective, their use is considered hazardous, due to the breaking of wires when the brushes are operated at high speed.

In considering the comparative efficiency of cleaning methods, as practiced by one railway which maintains detailed records of cleaning and painting and which employs pneumatic tools for 66 per cent of its steel cleaning and hand methods for 33 per cent, the engineer maintenance of way submitted the following data on hand cleaning versus pneumatic tools.

Comparative Cost Data, Hand Cleaning Versus Pneumatic Tools

	Hand Cleaning	Pneumatic Tools
Cleaning cost per ton	$1.12	$1.45
Painting cost per ton	$1.10	$1.90
Total labor cost per ton	$2.22	$3.35
Gallons of paint per ton	0.53	0.81
Cleaning cost per gallon of paint	$2.12	$1.79
Painting cost per gallon of paint	$2.08	$2.35
Total labor cost per gallon of paint	$4.20	$4.14
Ratio, cleaning to painting	1.02	0.76

Continuing his comments, this maintenance officer adds the following interpretation of these data in demonstrating the efficiency of these cleaning and painting methods:

"It will be noted from these figures that whereas the cost per ton is higher for pneumatic tools than for hand cleaning, the cleaning cost per gallon of paint applied is lower for pneumatic tools. The higher cost of applying paint after pneumatic cleaning indicates that a greater percentage of primer is applied and in more inaccessible places. The increased gallons per ton indicates the same thing."

Sand Blasting

Sixteen railways, representing 116,260 miles of lines, or 56 per cent of the total line mileage under consideration, reported the use of sand blasting for cleaning steel surfaces. The extent of its use varies from occasional practice to general use on one of the southwestern roads, although in this instance no specific proportion to the general steel cleaning program is mentioned. A southern road uses sand blasting for 30 per cent of its cleaning and two other railways employ this method for 15 to 20 per cent of their cleaning work. While in the opinion of a large proportion of railway maintenance officers, sand blasting produces most efficient results insofar as the cleaning of steel surfaces is concerned, the high cost of operation is cited as the predominant reason for its comparatively restricted use. The data on the use of sand blasting which was received in reply to our questionnaire is summarized in Table III.

TABLE III—Sand Blasting Steel Surfaces Prior to Recoating

No. of Roads	Proportion of Cleaning Programs	Miles of Line	Percentage of Total Miles of Line
2	30% to Gen. practice	11,042	5.3%
2	15% to 20%	12,445	6.2%
6	2% to 10%	31,984	15.4%
3	0.5%	39,770	19.2%
3	Occasional use	21,019	10.1%
16		116,260	56.2%

Flame-Cleaning Steel Structures

While the American Society for Testing Materials revealed certain advantages to be gained from the use of flames in preparing steel surfaces for painting, more than 20 years ago, it was not until 1936 that a practical method was developed. Ensuing progress has reached the point where the oxy-acetylene flame is now widely accepted for the descaling of billets, castings and forgings and more recently for the flame-cleaning and dehydrating of steel surfaces prior to applying paint and protective coatings.

In addition to removing loose scale and rust, the oxy-acetylene flame-cleaning process is designed to improve the surface to be painted as well as the conditions under which the protective coating is to be applied. Moisture is driven from the surface, leaving it warm and dry and the heat also prevents recondensation. The application of paint to the warm surface produces a thinning effect on the paint and lowers its surface tension, which imparts a wetting action and aids the paint in penetrating cracks, crevices and porous scale. In instances where the paint is brushed, it is claimed that the warmth makes for easier application and faster setting qualities.

Flame-cleaning structural steel is accomplished by the use of specially-designed burners which are passed over the surfaces to be cleaned in such manner as to subject surface scale to intense, high-temperature flames.

In the resulting action, the surface layer is raised to a high temperature which sets up stresses within the layer, causing it to expand and to free itself from the underlying cool, brittle layers before the steel is warmed enough to expand appreciably. Although some of the tightly adherent oxide scale, particularly on newly fabricated work, withstands the action of the flame, it is usually so tightly affixed that it protects the steel from corrosion and forms a good base for prime coats.

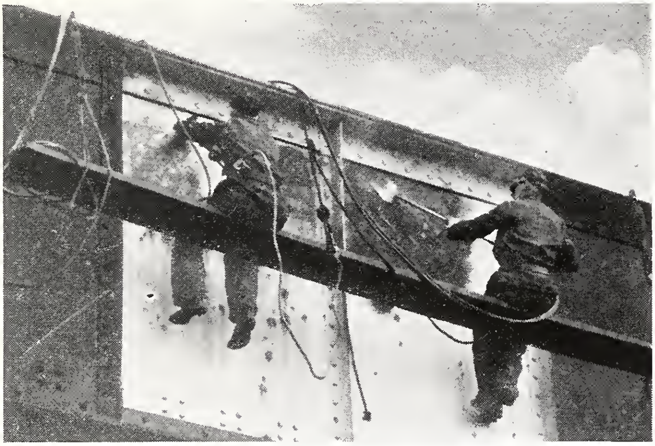
The application of the flame is followed in from 5 to 15 minutes by thorough wire brushing, using either pneumatic or hand brushes to remove any partially free scale, dirt, or rust. The fine dust, which usually remains after wire brushing, should be removed prior to the application of paint and old paint brushes serve as good dusters for this purpose. The cleaned surfaces should be painted before they reach the temperature of the surrounding air and while the time interval varies, it should not exceed two hours. When closing up work at the end of the day, the entire process should be so governed that all cleaned areas will be coated in order to prevent oxidation of cleaned surfaces and to preclude the necessity for a second cleaning operation on the following day.

In addition to the usual equipment that is necessary in the use of oxyacetylene flames, the principal item required for flame-cleaning is the special heating head. While some specifications prescribe the size and type of heads or burners for various applications, experience has shown that such requirements sometimes are unnecessarily restrictive. Various sizes and types of heads are in use, including flat and round tops. The former usually vary in width from 2 to 12 in., of which the 6-in. width seems well adapted to general use. The flame ports are about 0.020 inch in diameter and are spaced about ⅛-in. apart. Two end skids, provided for use on flat surfaces, space the head at the proper distance from the surface and serve as guides in the cleaning operation. Round heads or tips having hard-faced wearing rings are also available for cleaning rivet heads, fittings, corners and other projections. While for ordinary work the head or tip is attached to the blowpipe directly, extension arms are available for reaching more inaccessible surfaces.

Although the practical development of flame-cleaning structural steel is of such recent origin, the process has already been used by no less than 15 of the railways which were canvassed, representing 110,764 miles of lines, or the equivalent of more than 53 per cent of the total line mileage covered by this report. Five of these railways, representing 25,611 miles of lines, or 12 per cent of the total mileage covered, are using flame-cleaning to an extent ranging from 2 to 12 per cent of their total cleaning. The 10 remaining railways within this category, did not specify the extent to which flame-cleaning is being employed; however, they represent 85,153 miles of lines or slightly more than 41 per cent of the total mileage covered by replies to the questionnaire.

By reason of the fact that the adoption of flame-cleaning is of such recent origin and that its use for cleaning railway steel structures has been comparatively limited, representatives of the roads which are using this procedure are reticent in expressing their opinions. However, the engineer of bridges of one large system now believes that it is apparently just as efficient as sand blasting and the cost is considerably less. The assistant chief engineer of another road declared that after using flame-cleaning to some extent for more than two years, he has found it very efficient for the removal of heavy deposits of grease, dirt and rust from rail troughs and heavy deposits of rust scale from floor beams and girders.

An interesting experiment was reported by one of the committee members, a representative of a large railroad which uses hand cleaning methods for practically all of its steel structures. Eleven spans of 25-ft. lattice beams supporting a trainshed roof were cleaned of all loose scale and coated with an oil preservative. Six months later it was found that corrosion had not been checked effectively and the steel work was cleaned again prior to repainting. Both flame-cleaning and hand methods were used in the second experiment and accurate records were maintained. Flame-cleaning required 13 man hours and the total cleaning cost of labor and material amounted to $17.50 per beam. Hand cleaning methods required 26.1 man hours and the labor cost amounted to $18.27 per beam. In hand cleaning, an effort was made to duplicate the results of the flame-cleaning process by cleaning the entire surface area of each beam. Comparative results favored the flame-cleaning process in both appearance and cost of the finished work.



Many Roads Are Finding Flame-Cleaning with the Oxy-Acetylene Torch to Be a Highly Effective Method

The Use of Petroleum Products

Among the developments of the last decade has been the trend toward the use of petroleum products and compounds containing rust-inhibiting chemicals as a means of reducing maintenance expense and at the same time providing protection for steel structures. Although one of the railways answering our questionnaire has used petroleum oil to a small extent for such purposes during the last 30 years and while a second has employed similar means of protection for 15 years, it is only within the last 9 years that the use of petroleum oils and compounds impregnated with rust inhibitors have come into widespread use.

During that prolonged period when operating revenues receded to such extent that the curtailment of maintenance expenditures assumed a perennial character, maintenance officers were faced with serious and perplexing problems centering around the adequate protection of steel structures. It was during that period that one road after another adopted the use of petroleum products of some form, chiefly as an expedient in retarding corrosion and with the intention of carrying the structures through a period marked by drastically curtailed painting programs. In many instances the petroleum products were applied directly to corroded surfaces, without preliminary cleaning, thus eliminating a comparatively large item of expense and, since material costs were low and much of the application was made by spraying, the procedure offered temporary relief at least and at a cost commensurate with the limited funds which were available.

By the summer of 1935, the general use of petroleum products and compounds for the protection of steel surfaces was still in the experimental stage. However the movement had assumed such proportions that the matter received detailed attention in the committee report on Cleaning Steel Bridges Preparatory to Repainting, which was presented at the 1935 convention of our Association. Moreover, that report stated that one road had adopted the use of such products as standard practice and had discontinued cleaning rust from steel bridges prior to recoating, while the bridge engineer of a second road had decided to follow a similar procedure and that a third road was using a non-volatile penetrating oil successfully for similar purposes.

Petroleum Products and Compounds Containing Rust-Inhibiting Chemicals Are Being Used Extensively

Of the 33 railways which replied to our questionnaire, 22 roads with a combined mileage of 151,513 miles of lines, equivalent to 73 per cent of the total line mileage of this survey, reported the use of petroleum compounds and products for the protection of steel structures. Six of these roads, representing 28 per cent of the mileage of all roads reporting, use these products extensively; in fact, one road declared that very little cleaning of steel structures is necessary since practically all are coated periodically with an asphalt base oil. Another of this group uses petroleum compounds and products for 60 to 75 per cent of its painting program, still another uses products of this nature for 50 per cent of its steel painting program, while the three others within the same group report general use.

Eleven railways, comprising the second group within this category, have a total line mileage of 64,474, representing 31 per cent of the total line mileage for all roads reporting. Nine roads within this group do not specify the extent to which petroleum compounds and products are used for steel protection; of the others, one uses such products for 10 per cent of its steel painting program and the remaining road uses a petroleum compound for 5 per cent of its work.

In addition to the groups already described, five other roads, with 29,309 miles of lines, or 14 per cent of the line mileage of all reporting railways, are conducting field tests with various petroleum compounds and products for the protection of steel structures. On the other hand, two other railways with a total of 6,734 miles of lines report that after using certain petroleum products they were dissatisfied with the results and have discontinued their use.

Table IV presents a summary of the extent of the present use of petroleum products employed for the protection of steel structures as developed by this survey.

TABLE IV—Railways Using Petroleum Products for Protecting Steel

No. of Roads	Extent of Use Proportion of Painting Program	Line Mileage	Percentage of Total Line Mileage
1	Practically 100%	995	0.0%
3	Gen practice	39,834	19.2%
2	50% to 75%	16,901	8.2%
9	Not given	44,076	21.3%
2	5% to 10%	20,398	9.8%
5	Experimental	29,309	14.2%
22		151,513	73.2%

Cost of Cleaning Steel

Any extended study of the comparative costs of cleaning steel structures necessarily involves so many variables that the results are of doubtful value. However the data furnished this committee, during the course of its survey, present some features which are worthy of consideration. For instance, of the 33 railways reporting, 14 roads with 69,390 miles of lines or only about one-third of the total line mileage covered, maintain cost records of cleaning steel structures. Of the four roads who do from 99½ to 100 per cent of their cleaning by hand, only one maintains a cost record and while 17 others do from 50 to 90 per cent of their cleaning in the same way, only eight of these, comprising considerably less than half the mileage of this group, maintain cost records.

On the other hand, among the 25 railways reporting the use of pneumatic cleaning tools, the proportion of the roads which maintain cost records is considerably higher. For instance, both roads using this method for 75 to 95 per cent of their cleaning keep cost records, while the same is true of four roads out of seven others which use pneumatic cleaning tools for 50 to 74 per cent of their cleaning. Considering those nine railways, with 39,449 miles of lines, which report the use of pneumatic tools for 50 to 95 per cent of their cleaning, six of them with two-thirds of the group mileage maintain regular cost records.

Of the 16 railways reporting the use of sand blasting, seven, with 37 per cent of the line mileage within the group, reported the use of cost records. Three of these roads, which employ this method for 15 to 30 per cent of their cleaning, maintain cost records, and a fourth road, which uses sand blasting as a general practice, reported that the costs for this work are not known.

While replies to our questionnaire included cost figures covering a wide range, any attempted comparison naturally would involve the consideration of many pertient factors. The general situation in this respect has been aptly summarized by E. R. Needles in a portion of a paper presented before the American Society of Civil Engineers at Kansas City in 1940: "Some engineers are satisfied with steel cleaned for painting by the most slipshod hand methods, and others insist on sand blasting down to bright metal. One method of cleaning may cost 75 cents per ton; the more careful methods may cost several times as much; and the advocate of each method may consider his practice economically sound."

Cleaning Building Surfaces

Since our survey does not reflect the use of any new methods in removing paint from exterior wooden surfaces and inasmuch as detailed descriptions of the several methods in common use were presented in a report on The Inspection and Preparation of Wood Surfaces for Painting, which is included in the proceedings of the Association for 1938, those particular phases will not be elaborated upon at this time. However, replies to our questionnaire reflected in a measure the results of deferred building painting programs during the last decade.

Twelve railways, with a composite line mileage of 89,745, or 43 per cent of the total mileage covered in the survey, reported the necessity of extensive paint removal from the exterior surfaces of wooden buildings prior to repainting. Of these railways, nine representing 57,886 miles of lines or 28 per cent of the total mileage covered, reported that torches were used generally for removing paint, while the three remaining roads were using hand scrapers and brushes for that purpose. Burning outfits which utilize oxy-acetylene or propane gas are being used quite extensively and with good results. A considerable variation prevails in the proportionate cost of the removal to the total painting cost, but in the main, these proportions were lower for burning than for hand removal.

The number of painted brick buildings in general railway use is comparatively small and only two railways reported painting requirements of an extensive nature for such strutures. The general practice, insofar as the preparation of brick surfaces is concerned, involves no large problem and the use of wire brushes and scrapers usually suffices, while in some instances sand blasting is employed.

Apparently there is no general need for the extensive removal of interior paint coatings prior to redecorating, for only one road reported the necessity for such procedure.

A recent application of the flame-cleaning process was used successfully by an eastern road for the removal of a heavy accumulation of badly deteriorated paint from the concrete lining of a passenger terminal tunnel. About 15 coats of both waterproof and casein paint, of approximately ⅛-in. total thickness, were removed from an area of 5,400 sq. ft. in a rapid and economical manner, without causing any damage whatever to the surface of the underlying concrete. In this instance, flame-cleaning was resorted to after several of the ordinary methods of paint removal proved unsatisfactory.

DISCUSSION

President Church: We have just had presented to us a very interesting and comprehensive report on the methods now prevailing and under development in the removal of paint. We would like to hear some discussion of this subject and the meeting is now open for that purpose.

F. B. Robins (C. & O.): Mr. President, it would be very difficult for me to add anything to this splendid report. However, some details of our present methods might be of interest. On pneumatic cleaning, we are using a force of about 16 men, which is equipped with a 60-cu. ft. compressor, 8 pneumatic scrapers and 4 pneumatic chipping hammers. The chipping hammers are used mainly with long chisels, as long as 36 in. sometimes, to enable us to reach parts of bridges which have never been reached before by other cleaning methods. By this means, in one case, we have removed loose mill scale not touched since the bridge was put up in 1901. The great advantage of pneumatic tools is that they make it possible to do a much more thorough job, permitting you to reach points that just could not be reached with hand tools.

R. E. Caudle (M. P.): During the last few years we haven't had any serious paint problems on our road. About nine years ago we inaugurated a program of rust removal and went over all of our bridges. As a result, they are in fairly good condition so far as rust is concerned. We have our regular bridge paint gang for general painting, but generally our bridges are being taken care of by two or three men from the regular gang who apply compound to the deck members as required.

Flame-Cleaning on P. M.

A. L. McCloy (P. M.): I have the oxy-acetylene rust removing torches in my paint gang equipment, and they do nice work. They remove rust much faster than the chipping tools, but the men must be careful in the use of the torches to keep from getting burned with the rust oxide sparks. Gauntlet gloves should be worn and shirt sleeves should be extended into the gauntlets to keep from getting burned.

The torches are very good for removing rust scale from the inside of the lower ends of the batter posts of through trusses, which cannot be reached with the chipping tools.

We are trying a plan of paint protection as an experiment, and it will take time to prove its worth. We built a grade separation structure last year, for double track, involving three through girders and an I-beam ballasted deck. The bridge was painted with aluminum paint. Shortly, blisters formed on the I-beams of the floor system. After cleaning off the blisters, we spot painted the beams and then sprayed on a transparent waterproof coating.

Chairman Burpee: Mr. McCloy, I would like to clear up a question there. Is your failure coming from rust under the film or merely from the fact that the paint is peeling off due to other causes?

Mr. McCloy: The aluminum did not peel off, but formed spots or blisters which could be wire brushed off.

President Church: In your reference to scaling or chipping hammers in comparison with the torch, you said you could reach points to be cleaned better with the torch. In this comparison, did you have reference to pneumatic or hand-cleaning hammers?

Mr. McCloy: In the case of cleaning bad spots inside of large box girders of truss spans, it was formerly the practice for men to crawl inside these girders and attempt to clean them with hand tools — a most difficult job, if possible at all. For such work now, we have extensions on our burning torches, with which we reach down into the box members from the outside and burn off the scale.

Torch Dries Material

K. L. Miner (N.Y.C.): We use the acetylene torch in inaccessible places as mentioned by Mr. McCloy, and we derive another benefit that he failed to mention. That is, the torch dries the metal from which the scale is removed and leaves it suitable for the application of the new paint. No mechanical or hand tool will do that.

President Church: Mr. Miner, do you follow with a spray application of paint in those places?

Mr. Miner: If we can get to them, we put red lead on the spots from which the scale is removed. If not, we spray on the black paint. The aectylene flame will remove all the rust and dry everything so that the cleaned surface is in excellent condition to receive paint.

L. C. Winkelhaus (C. &. N. W.): I want to talk about removing paint from a brick building. We are modernizing a station painted with three or four coats of paint. The paint is peeling and I want to get if off. We are trying sand-blasting. This station is of common brick, and the sandblasting operation is taking considerable of the brick away along with the paint. We don't want to paint again. I wonder if anyone has had experience with stuccoing or guniting a building after removing the paint, and just what is the best method of taking off the paint where the work is to be followed by stuccoing or guniting.

Removing Paint From Brick

L. E. Peyser (S. P.): Mr. Chairman, that is an experience we have just gone through in remodeling a station on our line. It is a brick building, the face brick being a little better than common brick; a type we call stock brick on the Coast. This station had been painted many times and the paint was badly alligatored. We decided we could sandblast it lightly or scrape it in some way, and started sandblasting. To our surprise, the sandblasting didn't have much effect on that old, tough, brittle paint; but we continued sandblasting until we got down to the dado, a point about six feet above the floor. From here down we struck a good coat of old red metallic paint, still tacky, which some one had applied years ago, and neither the sandblasting nor scrapers had any effect on it.

I was on the job and, as an experiment, we secured an old paving burner, which burned distillate and threw a flame about three or four feet long. The flame of this burner burned the metallic paint enough to make it brittle and easily removable by scraping or sandblasting. Up above, wherever we attempted to use the sandblast without burning, the sandblast would go through the paint and into the brick in spots so we discontinued this practice and burned all of the paint off, following up with a light sandblasting, which left the brick in excellent shape for stuccoing, with the surface rough enough for a good bond.

W. A. Huckstep (M.P.): During the last year, we removed some seven or eight coats of paint from a large two-story brick passenger station and office building. This was done with a low-pressure paint burning outfit, of which I think we now have four on the different divisions. We experimented with that brick building and it proved highly successful, because the paint was removed right down to the original brick surface without in any way damaging it. The low-pressure flame simply softened the paint and it was removed just as we remove it from frame buildings. Of course, there are certain places where we would not recommend using this method, such as under an eave trough or in places where the flame might get into a rat's nest or other highly inflammable material.

Chairman Burpee: In our information from the Baltimore & Ohio, they reported extensive cleaning of brick buildings. Perhaps Mr. Crites could enlighten us on the method used.

C. G. Crites (B. & O.): I have nothing to say on the subject.

Mr. McCloy: I might add information on the removing of paint on the batter posts of a bridge. The bridge had been up about 26 years and blisters had formed on the face from different causes. When we painted over these blisters, after cleaning, depressions were left in the new paint job. The chief engineer came along while we were working and wanted all the old paint taken off before repainting so there would be a smooth surface to paint over. We started to do this with a 6-in. burner. We wire-brushed the surfaces as we burned, but some paint still remained. We repeated the operation three or four times but the last coat of paint would not come off. The paint which resisted removal was a green graphite. Of course, we didn't care then whether it came off or not, because it was a perfect base film for repainting.

Temperature Important

Chairman Burpee: Several years ago, we encountered trouble of a nature similar to that explained by Mr. McCloy, that is, of paint blistering after the application of new material of approved characteristics—material which we knew was suitable for the application. I think in some instances, if a careful inspection of the old film is not made prior to repainting, trouble may be expected if the new material is applied over a film that has lost its flexibility. This trouble is likely to show up in anywhere from three to six months, particularly during the winter time when there are extremes in temperature.

C. R. Knowles (I.C.): My experience has been chiefly in the painting of steel tanks, that is, one of getting the metal clean and of using the proper coating. We are now using a petroleum base compound, such as Mr. Burpee mentioned in his report.

There is one thing in connection with the painting of bridges which is especially important, and that is the season or time of the year as it affects the temperature of the steel and the atmosphere. In the case of painting steel water tanks, one of the most important things to observe is that the atmospheric temperature is lower than that of the tank.

President Church: Mr. A. M. Knowles, you are familiar with methods of cleaning before the application of new paint. We would appreciate some comments from you.

A. M. Knowles (Erie): I can merely say that on our road we are cleaning mostly by the pneumatic and hand processes. We have used the burning process in one or two instances, but not at all extensively. We find pneumatic cleaning quite successful. We coat the parts of the bridges exposed to brine drip with petroleum products and are quite well satisfied with the results being secured. We paint other parts of bridges in the usual manner with red lead and some protecting top coat.

Flame-Cleaning Not New

Armstrong Chinn (Alton): The idea of flame cleaning is not at all new. To my personal knowledge, flame cleaning has been used around shipyards for at least 35 years. Of course, the method when I first saw it involved the use of the blow torch for cleaning the hulls of boats. I think they found it advantageous because it dried the surface so that the fresh paint applied would adhere much better. Therefore, while the flame cleaning of railroad structures may be relatively recent, the process itself has been in use for a long time.

Chairman Burpee: Among the roads reporting comparatively extensive use of the flame cleaning process was the Delaware & Hudson. In view of this, I wonder if Mr. Varker can add anything to the discussion.

J. L. Varker (D. & H.): This summer we painted three spans of a bridge across the Susquehanna river at Wilkes-Barre, Pa. That was our first trial of the flame process for cleaning bridge steel prior to painting. As somebody has already said, this method is very advantageous for cleaning the pockets where the vertical members meet the floor beams, chords, etc. We tried it on flat surfaces as well as in the pockets, and, while it loosened the paint, I think, so far as the cost is concerned, it was a little more expensive than the hand method. However, I am not sure of this. The foreman told me that his men, after they had used the method for a few weeks, wanted to use it before they used the wire brush.

After heating and cockling the paint, we used a pneumatic wire brush for cleaning off the burned paint and then followed up with a spray coat of red lead, and, lastly, the cover coat. We kept some records of the work, and, while they are not very complete, I think they will show some merit to the flame cleaning process. In our program of work for next year, we intend to do more flame cleaning. At that time, I thing we will be better able to speak of the merits of the process.

Removing Grease

Chairman Burpee: Mr. President, another point has occurred to me. It relates to the removal of grease. One man reported to the committee the successful use of flame cleaning for removing grease as well as comparatively heavy scale. Other remarks and information brought to our attention seem to show that grease should be removed by hand cleaning or other method. Can anybody give us information on this question?

President Church: Mr. Robins, can you give us any information on this?

Mr. Robins: Mr. President, we have had to remove grease only once, and at that time we used a solvent. I don't know exactly what this solvent was, except that is was for removing paint. It worked well in that case and we have used it since. We have also used naphtha to remove grease. Salt will work too.

President Church: Mr. Burpee, we are greatly indebted to you and your committee for this comprehensive survey on paint removal, which you have put together in such excellent shape.

High Points of Convention Reviewed

By Armstrong Chinn

Chief Engineer, Alton, Chicago

Armstrong Chinn

This has been a most unusual convention in several respects. It marks the end of our fiftieth year as an association and I think we have done a lot of good in those 50 years. That this association has rendered valuable service to our railroads is demonstrated by the fact that, after 50 years, we are still going strong and still doing the same high grade of work that we did at the beginning. Any association that exists for 50 years must be doing something worthwhile.

You who were here Tuesday night and heard C. R. Knowles tell of the early history of the association and the needs that brought it into being, as well as of the outstanding work that it has done in these 50 years, must feel proud to be members of such a worthwhile organization. As remarked by Elmer Howson during that meeting, I wonder what our bridge and building standards and methods would be like today if our association had not, in the early years, taken the initiative in developing these standards and methods.

This has been an unusual convention in that it has been held during a period of national emergency such as none of us have faced before, and such as I hope none of us will ever face again. It certainly makes the future uncertain, because we know there are many changes ahead — changes that are difficult to foresee at the present time. However, even amidst these uncertainties, we are certain that some of the fundamentals of life will remain. We must eat; we must wear clothes; we will require homes in which to live; we will need to heat those homes; and if we are to exist as a nation, we will have to transport a tremendous amount of material to meet the requirements of the present emergency. All of this will require transportation—a lot of it. I think that you will all agree that the railroads are the backbone of the transportation system of the country, and that since they are, we are all going to have important jobs to do for a long time. We must keep the railroads running. That is our job, and I think it is one we can well be proud of.

Timely Reports

I think this has been an unusual convention also because, never before, at least at those conventions that I have attended, have we had as timely and instructive reports from our committees or as splendid and informative addresses from men of national standing, as we have had at this convention. I think we can go from here with the feeling that we have been given information that is essential to solving the problems that lie immediately ahead of us. The old saying is, as you know, "Forewarned is forearmed." From the opening address by Mr. Gormley of the Association of American Railroads, to the final committee report by Mr. Burpee, the convention has been a series of educational experiences. Those fortunate enough to have been here for all of the sessions must feel that they have been repaid richly for the time spent. Nowhere else could they have gotten so much pertinent and useful information in so short a time.

It must have given all of you a sense of satisfaction to receive greetings from the Association of American Railroads, the American Railway Engineering Association, and our companion organization, the Roadmasters' and Maintenance of Way Association. These greetings show the interest that our superiors and associates, represented by these organizations, take in us and in our work, and I am sure that so long as we know we have the support of these men, we will have the incentive to go ahead with the work we are doing.

We heard several of our speakers during the convention say that some of our leaders in Washington have expressed the fear that the railroads will not be able to provide sufficient transportation during the present national emergency. I think you and I know better than that, and yet, we will have to do our part to see that there will be no failure.

There are only two things that could prevent the railroads from furnishing the transportation that will be required of them. The first would be their inability to get the materials necessary for adequate maintenance. The second would be the development of a condition, as occurred during the last war, where cars are not unloaded promptly, permitting the tying up of a large percentage of our cars.

Government Responsible

I think that the answer to both of these possibilities rests with our government, which controls the allotment of materials and which can largely control the unloading of cars. The fears expressed by some in Washington that the railroads cannot provide sufficient transportation, make me think that possibly they don't understand the meaning of "sufficient" any better than did the boy in the country school who was trying to learn the meaning of the word from his teacher. She had read the definition from the dictionary and had done her best to explain it to him, but he just didn't grasp the meaning of "sufficient." So finally, in desperation, she decided to give him an example. She said, "You live on a farm, don't you?"

He said, "Yes."

She said, "You water the cows sometimes, don't you?"

He said, "Yes."

"Well," she said, "Now, suppose that you go out and get one of the thirsty cows and lead her to the water; being thirsty, she drinks. She drinks a lot of water. She drinks all the water she wants and then she stops. Well, that is a sign that she has had sufficient. Do you understand now?"

"Oh, yes," he said, "I get it now."

She said, "Well, what does it mean."

He said, "It means a cow full of water."

The most important things that we have learned at this convention, as I see it, might be enumerated as follows:

First, we must all help to prevent a car shortage.

Second, we must conserve materials and equipment and so use them as to prolong their life to the maximum.

Third, we must maintain forces so they can do their work efficiently.

Fourth, we must protect existing structures and equipment from destruction by wear, neglect and sabotage.

Fifth, we must prepare to meet the new competition that is coming.

Sixth, we must carry on the usual and every-day maintenance, and find ways to do it more efficiently and cheaply.

Must Prevent Car Shortage

Considering first the first point —We must help to prevent a car shortage. You heard Mr. Gormley of the Association of American Railroads tell us of this in his opening address. You heard him say that the railroads must handle their business so shippers will not fear a car shortage, because, in fear of a shortage, they may try to load out more materials than can be unloaded, and thus create the very shortage they fear. You heard him say specifically that bridge and building men can help by unloading their materials promptly. In other words, by doing the same thing that we are asking of shippers.

I think we have been successful in that to date, because, as Mr. Gormley pointed out, the railroads are now getting 60 per cent more service out of their cars than they did in 1918, principally because they are unloading cars more promptly. In other words, we are "keeping them rolling." We must not fail in this, because, if we do, it may result in government control, which is something none of us wants.

H. R. Clarke, vice-president of the American Railway Engineering Association, said that we are facing tasks that will not be easy. We all like to go along in the same routine. That is the comfortable way, both physically and mentally. But with conditions as they are today, we must do a lot of thinking and a lot of work—more than we have ever done before. I think we all realize that and are ready to do just that, so I do not fear that we will have any trouble in taking care of the situation.

We can help in other ways—by keeping trains moving, by eliminating slow orders, and by seeing to it that there are no failures of structures that might delay trains. A. B. Hillman, president of the Roadmasters' Association, stressed the vital need of transportation during the present period of national defense. He felt certain that the critical times through which we are now passing will find railroad men meeting their new problems with the same skill and courage that they have always shown in the past.

Second—We must conserve materials and equipment and so use them as to prolong their lives to the maximum.

Conserving Materials

C. E. Smith, vice-president of the New Haven, told us what we are facing in our efforts to secure equipment and materials. With the "all-out" policy of our government in favor of Great Britain and other so-called democracies, he said that our supply of materials will, necessarily, be limited, and that it will be necessary for us to reduce our use of materials. However, he did give us the encouragement that, since the railroads are essential to national defense, we will get a relatively high rating in priorities — not as high as we would like to have, but much better than many industries.

G. A. Haggander, assistant chief engineer of the Burlington, told us how we can get along with fewer materials. He suggested the elimination of deferred maintenance. In other words, don't let deferred maintenance accumulate to the point where there is dire need of large quantities of materials which cannot be obtained. He stressed the need of painting to save metals, which will be hard to secure from now on. He pointed out that we can do repair jobs instead of replacement jobs, and thus save materials, and a number of ways in which we can save by welding and by the use of substitute materials, such as concrete, instead of steel.

In the committee report presented by Martin Meyer on the Repair and Protection of Bridge and Building Equipment, we were told how we can prolong the life of work equipment. In his address, C. E. Smith said that from now on, because of the government's need for machines and tools, it will be difficult, and certainly expensive, for the railroads to secure work equipment; and that we had better preserve what we have.

Labor Supply

Third—We must maintain our forces so they can do their work efficiently. P. O. Ferris, chief engineer of the Delaware & Hudson, pointed out the things that we can do to maintain our gangs. We must keep gangs that are efficient and know how to do their work, or we will be unable to maintain our properties adequately. In a period of expanding industrial activity, such as we are now in, it will be increasingly difficult to hold men, particularly when the government is paying a minimum of 90 cents an hour on ordance plant work, compared with the 44 and 45 cents that most of us are paying men on the sections. Mr. Ferris suggested that, among other things, we should make our men feel secure in their work and as comfortable and happy as possible.

In normal times, the railroads pay a fair wage. The work, if a man is competent, is more or less permanent. Most railroad work is not arduous. Some of it is hard, but it is not particularly strenuous. Then, there is always a pension to look forward to. These are advantages that are not offered by industry generally. When men working for the railroads have these benefits brought to their attention, it is hardly likely that they leave the service. I have discussed these conditions with my own men in the vicinity of ordnance plants, and, with the exception of a few of the younger men who were interested in securing an immediate higher wage, they have stayed with the railroad, knowing that this government work is temporary, and that when it is over there will be a lot of men looking for jobs.

Sabotage

Fourth—As I have already said, we must protect existing structures and equipment from destruction by wear, neglect or sabotage. E. P. Coffey, chief of the technical laboratory of the Federal Bureau of Investigation, told us during his luncheon address what the F. B. I. is doing to protect industry. He made numerous suggestions as to what the railroads can do to protect their properties, and urged that they contact the F. B. I. immediately if they learn of any attempts at sabotage.

Again, in their committee reports, Mr. Meyer, speaking of work equipment, and Mr. Burpee, on cleaning bridges, told what might be done to preserve equipment and structures. Mr. Hanley, in his report on welding in water service work, brought out how materials can be conserved in that class of work by the use of the welding torch.

Future Competition

Fifth—We must prepare to meet the new competition that is coming. Now, that is something to which we have not given the thought we should. There are many thousands of big bombing planes being built, and there are many thousands of army trucks being built. When this emergency is over, such equipment will not be left lying around idle. Most of the bombing planes will be converted into express planes and will go after the cream of the express business. The trucks, on the other hand, will certainly be used on the highways, and we will have keener competition than we have ever had before. We must be thinking about such competition and what we can do to meet it.

Mr. Winkelhaus, in the report of his committee on modernizing small stations, showed what we can do to make our properties pleasing in appearance and usefulness so that patrons will be attracted to our services as they are not now. We must be thinking of the comfort of our patrons or they will be leaving us later on. Those of you who heard that report will agree with me, I am sure, that it can be used almost as a handbook of information on how to modernize small stations. A. O. Lagerstrom, architect of the Milwaukee, enlarged on that subject.

Increase Efficiency

Sixth—We must carry on with our usual and every-day maintenance and find ways to do it more economically. With the competition that is coming and the labor difficulties which confront us, we will have less money to spend and will find it harder to get satisfactory labor. We need to be thinking about these things.

Of special interest in this connection was H. T. Livingston's report on the Possibilities of Off-

Track Equipment in Bridge Construction and Maintenance. I believe that, daily, we will find the need for using off-track equipment becoming greater. By using this equipment, we can do our work more economically and we can do it more rapidly. A number of manufacturers are working on the design of new machines that will help us in this respect.

When it comes to saving money by modernizing our water stations, I am sure we all know what to do after listening to the excellent address by A. B. Pierce of the Southern. As Mr. Pierce pointed out, in spite of the use of Diesel locomotives, water stations will be with us for a long time to come. Therefore, it is important that we keep our water stations in the best possible shape, and by so doing we can save a large amount of money.

One phase of maintenance we have with us every day is to prevent damage to our bridges and roadway by erosion. Erosion can be serious from the standpoint of causing traffic interruptions and delays, even if it does not cause an accident. A. B. Chapman and his committee, in a most comprehensive report, told us what to do about troublesome erosion problems.

Under this same heading comes the report of S. S. Long and his committee on efficient methods of transporting bridge and building and water service gangs, in which was brought out the possibilities of using trucks on the highways. With the high-speed schedules now being operated on our main lines and the infrequent service on many of our branch lines, it will become more and more necessary to use trucks to move men and materials efficiently, particularly those in the water service department.

In this summary, we must not overlook our friends in the Bridge and Building Supply Men's Association. C. C. Rausch, as president of that association, has given us the best exhibit that we have had in many years, and put on a dinner and entertainment that we will remember for a long time to come.

I think you will also agree that our president, Mr. Church, has done an outstanding job. The convention is the flowering of the year's work of the association. Our committees make their reports and we find great value in the information that they bring us, but we seldom think of all the work that lies behind these reports, particularly that of the president, who must co-ordinate and organize all of the committee work.

And may I make this suggestion in closing. If you have heard and learned things here that are helpful and beneficial to you, don't keep them to yourself, but go home and tell others who ought to be here with you, so they can join the association and get the benefits of these conventions. I believe the future of this association is secure in the hands of the officers whom I am sure you are about to elect. I have watched these men work and I know what they can do. As long as this association is headed by competent men, men who are willing workers, I know we can look to a successful future. Thank you.

President Church: We are greatly indebted to Mr. Chinn for this highly constructive survey of the accomplishments of this convention. I wonder if Mr. Howson would like to add any comments to Mr. Chinn's remarks?

Elmer T. Howson (Ry. Eng. & Mtce.): Mr. Chinn has done a masterful job. His summary is an innovation in the program this year and I think it has demonstrated its value. His summary has tied together the many valuable ideas that have come to us throughout these three busy days, and I think we will go away from this convention with its many benefits crystallized in our minds because of what Mr. Chinn has done for us.

This has been an outstanding meeting. We have had outstanding speakers; we have had extraordinary reports; and we have had a fine, attentive attendance. I would like to supplement what Mr. Chinn said in his closing remarks. If this convention has been worth while to you men here, and you will tell your associates and managements how you have profited from it, it will help in stimulating a similar and perhaps larger attendance in future years, and at the same time will put on your officers soon to be elected the responsibility to develop a program for next year that will be just as strong and beneficial as the program this year.

NEW MEMBERS 1940-41

Austin, P. R.—Associate
Barnhart, E. H.
Bunge, W. H.
Campbell, L. B.
Causey, A. E.
Chamberlain, B. J.
Chamberlain, P. C.
Collum, R. L.
Combs, G. P.
Cook, R. L.
Corbyn, M. H.
Davey, R.
Dayton, F. W.
Dorland, A. G.
Hanley, J. P.
Hanson, D. M.
Herrick, H. R.
Hilton, R. C.
Huckstep, W. A.
Huffman, W. H.
Hutchings, V. W.
Isaacs, D. W.
Kaullen, J.
Keith, L. P.—Associate
Leak, V.
Madison, F. W.
Montgomery, J. F.
Morrison, R. H.
Mortimer, E. L.
Perkins, S. P.
Rapier, L. F.
Robins, F. B.
Rucker, C. A.
St. Louis, J. E.
Spell, W. A.
Stephens, O. W.
Tubbs, H. D.
Walker, C. H.
Walker, George
Webster, T. J.
Weese, R. P.
Westwood, J. W.
Wiitala, A.
Worlow, D.
Yewell, J. E.

MEMBERS REGISTERED AT THE 1941 CONVENTION

Altogether, 215 members and guests from roads widely scattered over the United States registered their attendance and took part in the convention. Following is a list of those who registered.

Aagaard, Peter
Allen, G. A.
Anderson, W. L.
Baker, H. M.
Baker, R. C.
Bardwell, R. C.
Bear, Maxfield
Bechtelheimer, A. E.
Benson, G. W.
Berg, C. F.
Bost, M. A.
Boyd, G. E.
Buckingham, W. W.
Burpee, C. M.
Byrd, L. G.
Caines, W. W.
Campbell, F. G.
Campbell, L. B.
Carothers, M. D.
Cassidy, R. W.
Caudle, R. E.
Chamberlain, P. C.
Chapman, A. B.
Chinn, Armstrong
Church, H. M.
Clark, K. L.
Collier, P. B.
Colvin, A. A.
Combs, G. B.
Converse, D. W.
Cook, R. W.
Cowsert, L. A.
Crites, G. S.
Day, E. G.
Dayton, F. W.
Djuvik, Carl
Dorland, A. G.
Dove, R. E.
DuPree, James
Eisele, Charles
Elmquist, F. G.
Engman, V. E.
Eubank, C. C.
Evans, L. I.
*Filkins, A. J.
Firehammer, L. M.
Fournier, S. D.
Francis, B. F.
Friets, C. G.
Garis, L. D.
Gehr, B. F.
*Greenawalt, W. P.
Hadwen, J. L. D.
Hanley, J. P.
Harlow, A. W.
Harlow, H. M.
Harris, A. R.
Hauerslev, H. W.
Heck, J. E.
Hemstad, B.
Hillman, F. W.
Hogan, J. E.
Holman, G. H.
Howard, N. D.
Howay, B. J.
Howson, E. T.
Huckstep, W. A.
Hutcheson, F. W.
Johnson, D. H.
Johnson, Maro
Johnson, R. W.
*Keith, L. P.
Kerns, W. V.
Kimball, L. P.
Knetzger, E. J.
Knowles, A. M.
Knowles, C. R.
Krefting, A. S.
Kubly, I. J.
Kulp, B. R.
Kvenberg, S. E.
Lacher, W. S.
Lacy, W. J.
Landstrom, C. A.
Larsen, H. C.
*Lehon, Tom
Link, H. M.
Livingston, H. T.
Lockwood, J. F.
Lodeski, J. B.
Long, S. S.
Luck, R. P.
McCloy, A. L.
McKay, A. G.
McMahon, T. D.
Madson, H. C.
Manning, D. A.
Marks, C. L.
Masters, F. H.
Merrill, B. W.
Merwin, P. B.
Meyer, M.
Miner, K. L.
Moore, A. J.
Moore, I. A.
Morrison, R. H.
Nelson, E.
Penhallegon, J. R.
Pennington, L. R.
Peyser, L. E.
Rapier, L. F.
Robins, F. B.
Roof, W. R.
Salmon, J. M., Jr.
Secker, J. W.
Singer, E. W.
Sirel, A. A.
Smith, C. E.
Soothill, F. H.
Spell, W. A.
Strate, T. H.
Sweet, W. A.
Tanner, E. E.
Thomas, M. E.
Tratman, E. E. R.
Tubbs, H. D.
Vandenburgh, E. C.
Varker, J. L.
Vreeland, J. S.
Wait, R. E.
Walden, M. P.
Walker, C. H.
Walker, George
Watson, Walter
Weir, K. J.
White, F. W.
Whitehouse, B. M.
Wilbur, William
Williams, N. H.
Winkelhaus, L. C.
Yates, D. C., Jr.

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*Associate Member

Bridge and Building Supply Men's Association Exhibit

October 14-16, 1941

Thirty-five manufacturers of equipment, materials and appliances used in the construction of railway bridges, buildings, water service and allied facilities, presented an exhibit of their products under the auspices of the Bridge and Building Supply Men's Association, in connection with the forty-eighth annual convention of the American Railway Bridge and Building Association at the Hotel Stevens, Chicago, on October 15, 16, and 17.

The officers of the supply association who planned and were responsible for the exhibit, which was held in the exhibition hall immediately adjacent to the convention room were: President, C. C. Rausch, Dearborn Chemical Company, Chicago; vice-president, W. S. Carlisle, National Lead Company, Chicago; secretary, R. Y. Barham, Armco Railway Sales Company, Chicago; and treasurer, F. A. McGonigle, Mall Tool Company, Chicago.

A list of the exhibiting companies, together with the products on display and the names of their representatives follows:

List of Exhibitors

Air Reduction Sales Company, New York—Electric welding unit and electrodes; oxy-acetylene welding and cutting apparatus; flame cleaning tip—C. B. Armstrong, C. Daly and E. F. Turner.

American Lumber & Treating Company, Chicago—Samples of Wolmanized timber and illustrations of its use—Robert R. Clegg, Henry Garnjobst and R. B. Putman.

Armco Railroad Sales Company, Middletown, Ohio—Samples of Armco's pipe and illustrations of applications; metal building sections; crib walls; air pipe; insulated pipe units—R. Y. Barham, E. T. Cross, R. B. Faries and J. D. Taylor.

Buda Company, Harvey, Ill.—Track and bridge jacks; motor car; track and car jacks—R. M. Blackburn, H. H. Cohenour, W. Ebbert, R. B. Fisher, R. K. Mangan, D. Richards, S. W. Sanford and R. P. Williamson.

Byers Company, A. M., Pittsburgh, Pa.—Radiant heating; samples of wrought iron; samples of pipe, angles, pipe angles and bars—Richard Angel, G. R. Coffey, William Damberg, Kenneth Knapp and D. M. Stembel.

Celotex Corporation, Chicago—Samples of insulation; wallboard; cold storage insulation; interior finish; roofing; gypsum wallboard—J. H. Bracken, W. G. Rogers and H. A. Winandy.

Chicago Pneumatic Tool Co., New York—Portable air compressor; pneumatic steel and wood drills; pneumatic rock and concrete drills; pneumatic paving breakers; pneumatic clay diggers; pneumatic back-fill tampers; pneumatic sump pump; pneumatic wrenches; pneumatic grinders; electric grinders and drills—S. A. Congdon, H. R. Deubel, T. P. Harris, W. J. Pallowick, E. S. Rossell and E. S. Stevens.

Dearborn Chemical Company, Chicago—No-Ox-Id rust preventives; sealing compound for wood water tanks; aluminum protective coating; pipe coating, wrappers for protection of underground pipe; chemical pumps; proportioner—Don Bishop, E. A. Goodnow, Walter Hinsch, C. I. Loudenback, A. C. Moeller and C. C. Rausch.

Paul Dickinson, Inc., Chicago—Roof ventilators; smoke jacks; stove jacks; roof drains; exhaust heads; floor scupper; deck drains; blast plates—A. J. Filkins, E. M. Filkins and H. Knutson.

Joseph Dixon Crucible Company, Jersey City, N. J.—Industrial paints; graphite greases; pipe joint compound; samples of graphite; literature on paints and graphite products—E. C. Bleam and W. Skea.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.—Bridge jacks—E. C. Gunther and J. F. Van Nort.

Independent Pneumatic Tool Company, Chicago—Electric and pneumatic portable tools—A. Anderson, J. Caswell, G. H. Du Sell, R. G. Faverty, N. C. Hurley, Jr., N. C. Kirchner, W. A. Nugent, L. Orland, A. Russell, T. Seward and F. Schiel.

Johns-Manville Sales Corporation, New York—Samples of transite pipe; corrugated transite roofing and siding; asbestos roofing and siding shingles; transite conduit; asphalt tile flooring; asphalt shingles; built-up roofing; prepared roofing; pipe insulation; asbestos wainscoting and wallboard; mechanical packing; asphalt plank—P. R. Austin, R. J. Offutt, T. O'Leary, Jr., W. G. Morehead, H. R. Poulson, W. W. Prosser, F. C. Vandervort and L. T. Youhn.

Joyce-Cridland Co., Dayton, Ohio—Bridge and track jacks; car and locomotive jacks; building jacks—Huston Brown C. N. Thulin and E. E. Thulin.

Koppers Company, Wood Preserving Division, Pittsburgh, Pa.—Photographs of pressure-treated forest products, bridges, culverts, trestles, water tanks, coaling plants and station platforms—H. C. Busch, M. F. Cravey, John Grennan, A. R. Nickel and G. C. Rosenquist.

The Lehon Company, Chicago—Asphalt shingles; prepared and built-up roofing; cold process built-up roofing; roofing and flashing compounds; literature on roofing; waterproofing materials—John Eipper, Tom Lehon, T. L. Kennedy, E. A. Leonard, John W. Shoop and Harry Wolfe.

Mall Tool Company, Chicago—Gas and electric-driven machines for vibrating concrete and surfacing concrete, with attachments for grinding, pumping water, drilling, boring, driving lag screws, wire scratch brushing and sanding; pneumatic chain saws and cross-cut saws; electric saws; drills; grinders; and chain saws—Robert Burgwald, Stanley Gromnicki, A. W. Mall, F. A. McGonigle and N. Rehnquist.

Massey Concrete Products Corporation, Chicago—Literature on concrete pipe, piling, concrete cribbing and crossing slabs—Ross Clarke, David A. Hultgren and W. L. McDaniel.

Master Builders Company, Cleveland, Ohio—Samples of floor wearing surfaces; rust joint iron; non-shrink aggregate for concrete bonds; reground portland cement paint for concrete surfaces: liquid quick-setting compound; puzzolanic cement dispersing agent for mass concrete; membraneous curing compound; masterplate—D. H. Lee, C. A. Lyon and B. R. Wood.

National Lead Company, New York—Red lead; white lead; white lead paint; red lead paint: literature on red lead paints and the use of white lead—Ralph Baker and Hugh M. Millen.

Overhead Door Corporation, Hartford, Ind.—Overhead door—R. M. Beal, J. Hale, W. Swanson, A. C. Thomas, W. E. Walbert and H. W. Wormser.

Oxweld Railroad Service Company, Chicago—Flame cleaning apparatus; soldering and brazing outfit; complete cutting outfit; photographs of pipe welding, flame cleaning and dehydrating, pressure butt welding of rails, and flame hardening of rail ends; flood lights; samples of welded pipe and wrinkle-bent pipe—Lem Adams, C. J. Gavin, E. B. Hall, Jr., Henry Hoffman, S. B. Hopkins, P. Hunter, Jr., and G. B. Moynahan.

Patterson-Sargent Company, Cleveland, Ohio—Bridge, building and car paints; and literature on bridge paint—Geo. W. Anderson, Ben Bowman and W. H. McBride.

Railway Engineering and Maintenance, Chicago—Copies of publication—G. E. Boyd, F. R. Brewster, C. M. Burpee, S. W. Hickey, N. D. Howard, E. T. Howson, C. W. Merriken, H. A. Morrison and J. S. Vreeland.

Railway Purchases and Stores, Chicago.

Ruberoid Company, New York and Chicago—Asbestos roofing and siding shingles; asphalt shingles and prepared roofing; models of built-up roofing—Geo. R. McVay.

Sherwin-Williams Co., Chicago—Display cans of paint; exposure panels; display panels; literature on finishes—R. D. Baker, G. A. Dorwart, H. M. Faber, W. J. Montgomery, E. M. O'Brien and C. A. Proseus.

T. W. Snow Construction Co., Chicago—Enginehouse door hanger—J. E. Dupree and B. S. Snow.

The Stanley Works, Stanley Electric Tool Division, New Britain, Conn.—Portable electric power saws; portable electric power drills; portable electric power hammers; portable electric sanders; portable electric power unishears; portable electric power nut and lag screw setter—E. C. Koenig, A. J. Peterson, P. C. Platt and L. R. Warnock.

Timber Engineering Company, Washington, D.C.—Timber connectors; termite shields; and literature on connectors and timber design—J. B. Jordan and L. P. Keith.

U. S. Wind Engine & Pump Company, Batavia, Ill.—Pump jack; tank stuffing box; float valves—H. W. Beem and A. Swanson.

Wailes Dove-Hermiston Corp. Westfield, N.J.—Displays of bitumastic enamel on pipes and floor surfaces; chromastic aluminum; chromastic metal primer; bitumastic black solution; bitumastic super-service; florex floor enamel; bituglass industrial enamel; bitumastic exterior-interior paint; literature on all foregoing—photographs of coal bunkers; railway bridges; cranes, water tanks painted with bitumastic—J. J. Clancy and C. V. Lambe.

Warren Tool Corporation, Warren, Ohio—Flex-toe claw bar—W. H. Bon and Oscar Youngquist.

Wheeler Lumber, Bridge & Supply Co., Des Moines, Iowa—Laminex railway crossing; lag bolt fastening; laminex literature—C. M. Mitchell.

Worthington Pump & Machinery Corp., Harrison, N. J.—Pneumatic concrete breaker; pneumatic rock drill—Paul Blakeley and Harry W. Miller.

	1891-2	1892-3	1893-4	1894-5
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stanndard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	G. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-6	1896-7	1897-8	1898-9
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	J. L. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. F. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. P. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	H. H. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	J. S. Lemond	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	H. Rettinghouse	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullem	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	W. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President......	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres....	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres....	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres....	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres....	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.....	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec......	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President......	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres....	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres....	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres....	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres....	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.....	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec......	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President......	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres....	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres....	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres....	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres....	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.....	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites.	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President......	Armstrong Chinn	A.E.Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres....	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres....	A.E.Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres....	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres....	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.....	C. A. Lichty	C. A. Lichty		
Secretary.....	....	....	F. O. Whiteman	A. G. Shaver
Treasurer.....	....	....	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

LIST OF ANNUAL CONVENTIONS

No.	Place	Date	Membership	Enrollmen
1	St. Louis, Mo.,	Sept. 25, 1891	60	...
2	Cincinnati, Ohio,	Oct. 18-19, 1892	112	24
3	Philadelphia, Pa.,	Oct. 17-19, 1893	128	27
4	Kansas City, Mo.,	Oct. 16-18, 1894	115	38
5	New Orleans, La.,	Oct. 15-16, 1895	122	40
6	Chicago, Ill.,	Oct. 20-22, 1896	140	36
7	Denver, Colo.,	Oct. 19-21, 1897	127	43
8	Richmond, Va.,	Oct. 18-19, 1898	148	34
9	Detroit, Mich.,	Oct. 17-18, 1899	148	32
10	St. Louis, Mo.,	Oct. 16-18, 1900	143	45
11	Atlanta, Ga.,	Oct. 15-17, 1901	171	46
12	Minneapolis, Minn.,	Oct. 21-23, 1902	195	52
13	Quebec, Canada,	Oct. 20-22, 1903	223	65
14	Chicago, Ill.,	Oct. 18-20, 1904	293	104
15	Pittsburgh, Pa.,	Oct. 17-19, 1905	313	62
16	Boston, Mass.,	Oct. 16-18, 1906	340	81
17	Milwaukee, Wis.,	Oct. 15-17, 1907	341	91
18	Washington, D. C.,	Oct. 20-22, 1908	368	99
19	Jacksonville, Fla.,	Oct. 19-21, 1909	393	79
20	Denver, Colo.,	Oct. 18-20, 1910	428	117
21	St. Louis, Mo.,	Oct. 17-19, 1911	499	102
22	Baltimore, Md.,	Oct. 15-17, 1912	524	103
23	Montreal, Que.,	Oct. 21-23, 1913	570	100
24	Los Angeles, Cal.,	Oct. 20-22, 1914	586	126
25	Detroit, Mich.,	Oct. 19-21, 1915	665	159
26	New Orleans, La.,	Oct. 17-19, 1916	710	154
27	Chicago, Ill.,	Oct. 16-18, 1917	704	168
28	Chicago, Ill.,	Oct. 15-17, 1918	716	119
29	Cleveland, O.,	Oct. 21-23, 1919	776	196
30	Atlanta, Ga.,	Oct. 26-28, 1920	840	172
31	New York, N. Y.,	Oct. 18-20, 1921	850	207
32	Cincinnati, Ohio,	Oct. 17-19, 1922	865	167
33	Seattle, Wash.,	Oct. 16-18, 1923	846	140
34	Kansas City, Mo.,	Oct. 21-23, 1924	837	202
35	Buffalo, N. Y.,	Oct. 20-22, 1925	759	172
36	Richmond, Va.,	Oct. 12-14, 1926	750	155
37	Minneapolis, Minn.,	Oct. 18-20, 1927	754	224
38	Boston, Mass.,	Oct. 23-25, 1928	755	211
39	New Orleans, La.,	Oct. 15-17, 1929	755	200
40	Louisville, Ky.,	Oct. 21-23, 1930	713	147
41	Chicago, Ill.,	Oct. 16-18, 1934	592	153
42	Chicago, Ill.,	Oct. 15-17, 1935	547	139
43	Chicago, Ill.	Oct. 20-22, 1936	588	129
44	Chicago, Ill.,	Oct. 19-21, 1937	566	147
45	Chicago, Ill.,	Oct. 18-20, 1938	589	139
46	Chicago, Ill.,	Oct. 17-19, 1939	546	145
47	Chicago, Ill.,	Oct. 15-17, 1940	610	167
48	Chicago, Ill.	Oct. 14-16, 1941	594	141

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1. The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussions unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1. The membership of this association shall be divided into five classes, viz: Members, life members, associate, honorary and junior members.*

Section 2. A member shall be a person in a responsible position in connection with railway bridge and building work, or in the employ of a public regulatory body, a professor of engineering in a college, an engineering editor, or a government or private timber expert. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3. To be eligible for a life membership a member must have belonged to the association for at least ten years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of active membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2, of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of active members except that of holding office and shall be exempt from the payment of dues.

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*Amended October 16, 1941.

Section 6. A junior member shall be a person who is a graduate of a recognized engineering school, or who has been employed for at least two years in the design, maintenance or construction of railway bridges, buildings or structures. Applicants shall be at least 21 years of age and they shall be elected in the manner prescribed for members, in Section 2 of this article. Juniors shall have all the rights of members except that of holding office. When the attainments of a Junior are such as to qualify him as a member, he may apply for promotion and the Executive Committee shall authorize such promotion when qualifications warrant the action. Unless a Junior is promoted, his membership shall cease automatically when he becomes 28 years of age.*

Section 7. Any member guilty of conduct unbecoming a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

Section 8. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 9. Only active members shall hold office in this association, and only active and life members shall be entitled to vote in the election of officers or selection of place for holding annual convention.

ARTICLE IV.

OFFICERS

Section 1. The officers of this association shall be a president, four vice-presidents, a secretary, a treasurer and six directors who with the most recent past president shall constitute the executive committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members, shall be privileged to attend all meetings of the executive committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1. The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association but shall not have the power to render the association liable for any debt beyond the amount then in the treasury and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any active member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for reëlection.

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*Amended October 16, 1941.

Section 2.† The president, four vice-presidents, secretary and treasurer shall hold office for one year and the directors for two years, three directors being elected each year. All officers retain their offices until their successors are elected and installed.

Section 3.† The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the executive committee.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1. Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing but may receive others into affiliate membership. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee of the assocation approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

BY-LAWS

TIME OF MEETING

1. The regular meeting of this association shall convene annually on the third Tuesday in October at 10 a. m.

PLACE OF MEETING

2. The place of holding the next annual convention shall be selected by ballot at the annual meeting of the association. All the places proposed

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†Amended October 17, 1940.

*Article adopted 1922.

shall be submitted to a ballot vote of the members present at the annual business session and the place receiving a majority of all votes cast shall be declared the location of the next annual meeting. If no place receives a majority of the votes cast, the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

3. It shall lie within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

DUES

5. The annual dues, for the fiscal year ending September 30, and payable in advance, shall be as follows:*

Members, $4.00; Associate Members, $3.00; Junior Members, $2.00.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10. After each annual meeting the president shall appoint a committee of five members, not officers of the association, of whom two at least shall be past presidents, and two of whom shall have served on the committee the previous year, which shall prepare a list of names of nominees for officers to be voted on at the next annual convention, in accordance with Article VI of the constitution, said list to be read at the first session of the second day of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee

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*Amended October 16, 1941.
†Amended October 17, 1940.
‡Adopted October 17, 1940.

of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to coöperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Selection of place for next annual meeting.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise all discussions shall be governed by Robert's rules of order.

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†Amended October 17, 1940.

DIRECTORY OF MEMBERS

As of June 1, 1942

Aagaard, P., Supt. of Bldg., I. C. R. R., Chicago (Retired).
Aaron, H. C., Insp. B. & B., W. M. Ry., Cumberland, Md.
Adkins, H. O., Mast. Carp., D. & R. G. W. R. R., Salt Lake City, Utah
Ailes, N. C., 12 Adams Place, Delmar, N. Y.
Aldrich, L G., Br. For., N. Y. N. H. & H. R. R., South Braintree, Mass.
Alexander, L. B., Ch. Dftsman, M. C. R. R., Detroit, Mich.
Allen, G. A., Br. Inspr., C. & O. Ry., Clifton Forge, Va.
Allen, T. H., Supv. B. & B., C. & O. Ry., Hinton, W. Va.
Anderson, August, Gen. For. B. & B., L. S. & I. Ry., Marquette, Mich. (retired)
Anderson, G. F.,For. B. & B., Sou. Pac. Co., Roseville, Cal.
Anderson, J. L., Supv. B. & B., M. P. R. R., Osawatomie, Kans.
Anderson, R. D., Div. Engr., C. & N. W. Ry., Huron, S. D.
Anderson, W. L., Office Engr., C. & N. W. Ry., Chicago.
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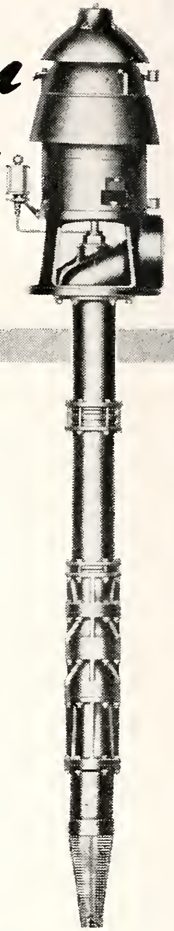

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52 RAILWAYS

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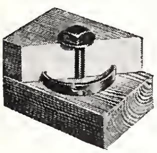

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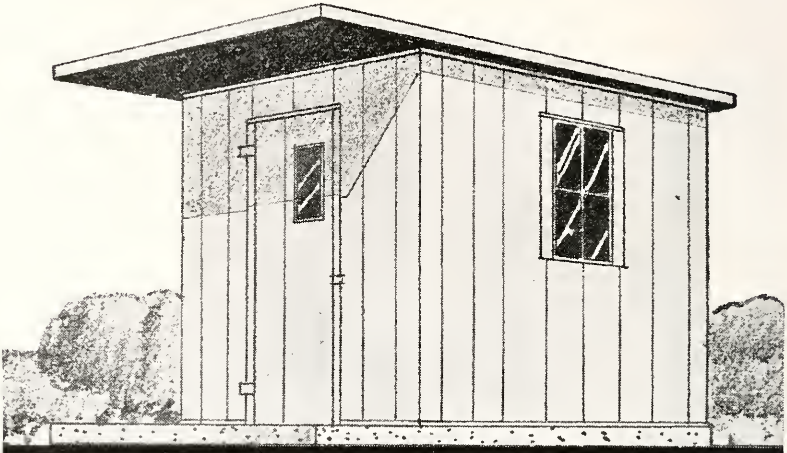

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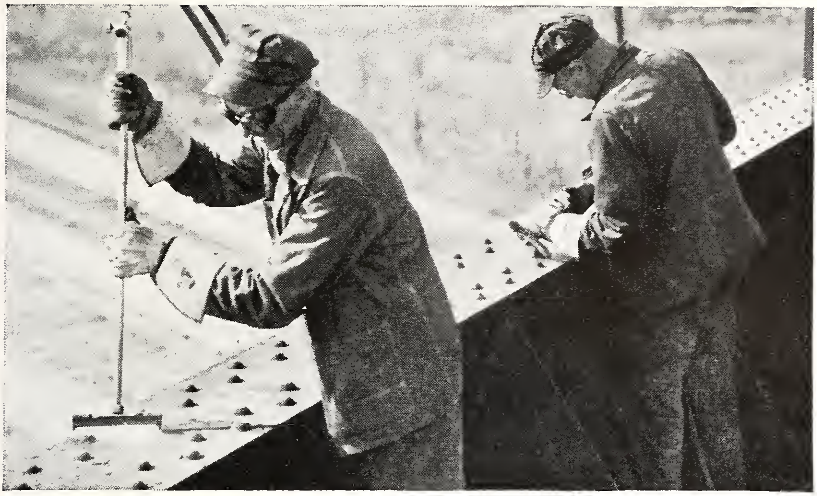

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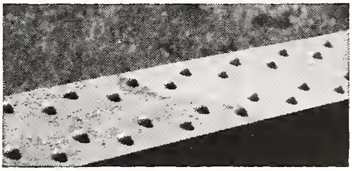

This unretouched close-up shows a section of the bridge girder cover plate that has been flame-cleaned (right) adjacent to a section still to be done (left).

For the Bridge and Building Association report on this subject see page 180 of this publication.

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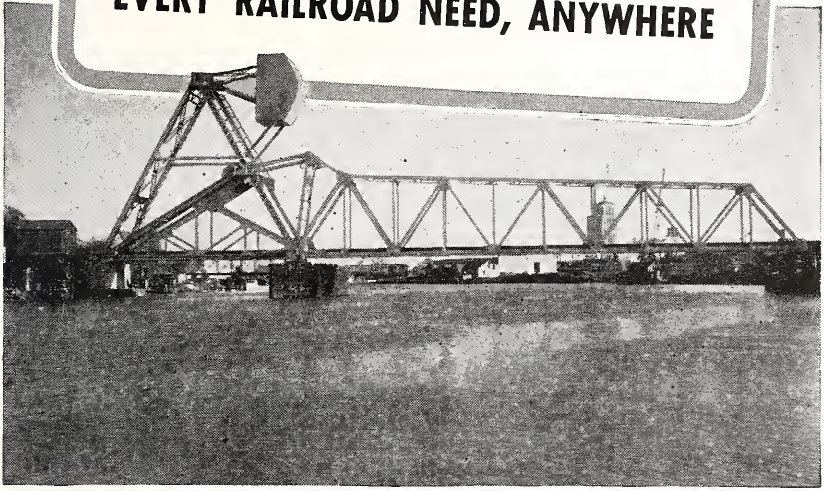
EVERY TYPE OF STRUCTURE FOR EVERY RAILROAD NEED, ANYWHERE



The ABT-type bascule bridge over the Neches River at Beaumont, Texas, was built for the Texas & New Orleans Railroad Co. It replaces an older swing span and provides a 200-ft. navigation channel in place of the two former 98-ft. channels. Though built on the old structure's alignment, traffic was maintained throughout the construction period excepting for an 11-hour interval required for floating-out the older span. The entire superstructure, ready for service, and the removal of the old bridge was under contract to American Bridge Company.

WITH satisfaction, American Bridge Company looks back through the years of its railroad construction history. During that time, it has encountered every type of structural need from the smallest to the largest, from turntables to buildings, bridges, viaducts and subways.

Always there has been the feeling that we, too, are a part of the railroad business. We have been so close to its many developments, have specialized for so long on this character of work. We like to feel that every job we undertake will stand as an enduring testimonial to our skill and our facilities—proof of our ability to serve.

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BUDA "Klinch Klaw" JACK

Above—Shows Buda "Klinch Klaw" Jack pulling out a headless bolt.

—Ideal for Pulling Bolts and Spikes from Bridges and Trestles

- √ Pulls all types of bolts, including headless ones.
- √ Pulls bolts between the ties from 20 inches below surface.
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It is the only jack of its kind on the market today! Write for Bulletin No. 957-B which completely describes this jack.

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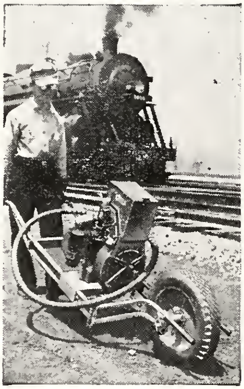

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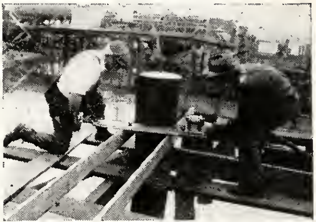

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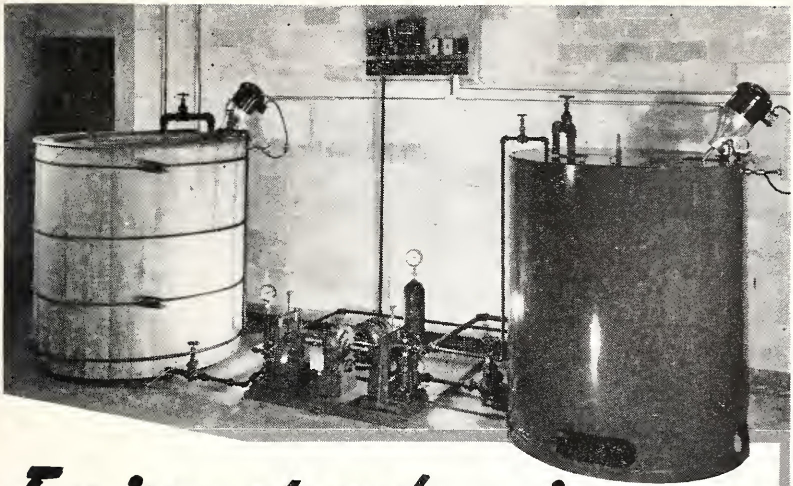

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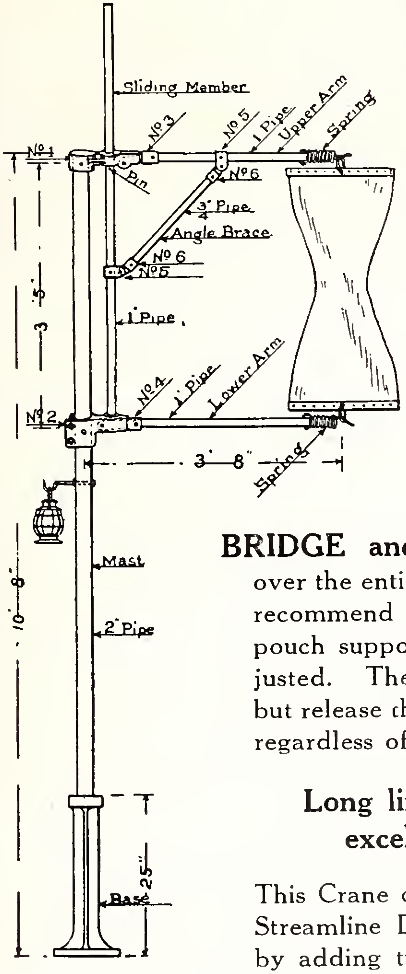
BARKER MAIL CRANE



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All Parts interchangeable.

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This Crane can be converted into a Streamline Dual Service if desired, by adding two additional arms.

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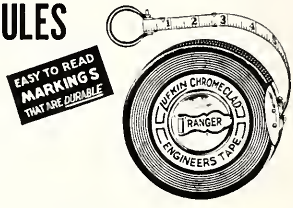

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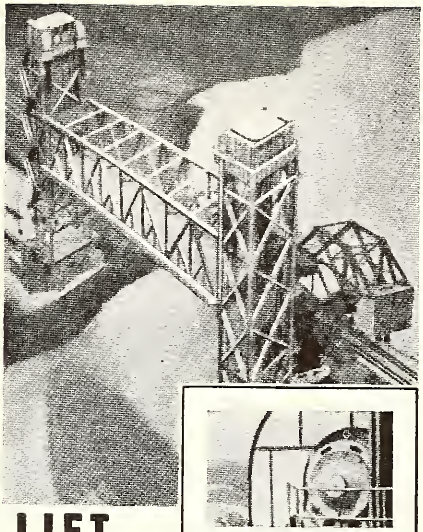
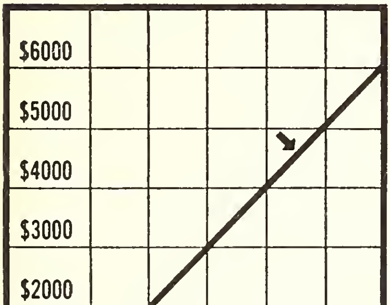


Chicago's Torrence Avenue Bridge and one of the 8 Bantam Bearing equipped million pound capacity sheaves on which it lifts.



For economical operation of movable bridges you must attack the problem while it is still in the blue print stage. Many successful bridge designers have wisely consulted Bantam Bearing Engineers at the outset.

The result may be seen in the accompanying graph which shows the actual power savings in one typical case. $4500 saved in power alone in 4½ years. In addition, there were big savings due to lowered lubrication costs and a considerable reduction in the size of operating motors and machinery.

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